Service Manual

Models
G10-55A
G12-55A

3126019

Revised
January 5, 2011

An Oshkosh Corporation Company

EFFECTIVITY PAGE

December, 2003 - A - Original Issue Of Manual

July 16, 2004 - B - Revised Manual

March 11, 2005 - C - Added Main Pump Information

July 7, 2006 - D - Revised Manual

April 19, 2007 - E - Revised pages 2.7, 3.16, 5.11, 6.3, 6.4, 7.10, 8.4, 8.6, 8.20, 9.18 & 9.22.

August 8, 2007 - F - Revised pages 2.7, 7.4, 7.5, 7.6, 7.14, 9.4, 9.9, 9.12, 9.15 & 9.17.

May 1, 2008 - G - Revised Danger, Warning & Caution text and pages 1.4, 2.10, 3.14, 3.15, 3.16, 3.17 & 3.19.

January 5, 2011 - H - Revised page numbers and pages 2-3 thru 2-10, 2-13 thru 2-19, 3-4 thru 3-29, 4-6 thru 4-10, 5-4, 5-5, 5-9 thru 5-11, 6-3, 6-6, 7-6 thru 7-9, 7-11 thru 7-15, 8-3 thru 8-12, 8-14 thru 8-25, 9-5 thru 9-12, 9-15 thru 9-21, 9-23, 9-25 thru 9-28, 9-31, 9-32, 9-34 thru 9-36 & 9-42 thru 9-54.

EFFECTIVITY PAGE

SECTION CONTENTS

Section	Subject	Page
Section 1		
Safety Practices		**1-1**
1.1	Introduction	1-2
1.2	Disclaimer	1-2
1.3	Operation & Safety Manual	1-2
1.4	Do Not Operate Tags	1-2
1.5	Safety Information	1-2
1.6	Safety Instructions	1-3
1.7	Safety Decals	1-4
Section 2		
General Information and Specifications		**2-1**
2.1	Replacement Parts and Warranty Information	2-2
2.2	Torque Charts	2-3
2.3	Specifications	2-11
2.4	Fluid and Lubricant Capacities	2-15
2.5	Service and Maintenance Schedules	2-17
2.6	Lubrication Schedules	2-20
Section 3		
Boom		**3-1**
3.1	Boom System Component Terminology	3-3
3.2	Boom System - Four Section	3-4
3.3	Boom Assembly Maintenance	3-4
3.4	Complete Boom Removal/Installation	3-5
3.5	Boom Section Removal/Installation	3-6
3.6	Extend/Retract Chain Removal/Installation	3-16
3.7	Boom Section Separation Adjustment	3-18
3.8	Hose Carrier Assembly Removal/Installation	3-20
3.9	Quick Switch Assembly	3-23
3.10	Boom Head - Mounted Winch	3-24
3.11	Boom Wear Pads	3-24
3.12	Boom Extend and Retract Chains	3-25
3.13	Forks	3-29
3.14	Troubleshooting	3-30
Section 4		
Cab and Covers		**4-1**
4.1	Operator’s Cab and Covers Component Terminology	4-2
4.2	Operator’s Cab	4-3
4.3	Cab Components	4-3
4.4	Cab Removal	4-8
4.5	Cab Installation	4-9

Section	Subject	Page
Section 5		
Axles, Drive Shafts, Wheels and Tires		**5-1**
5.1	Axle, Drive Shaft and Wheel Component Terminology	5-2
5.2	General Information	5-3
5.3	Axle Assemblies	5-3
5.4	Drive Shafts	5-9
5.5	Wheels and Tires	5-10
5.6	Brakes	5-11
5.7	Towing a Disabled machine	5-11
Section 6		
Transmission		**6-1**
6.1	Transmission Assembly Component Terminology	6-2
6.2	Transmission Serial Number	6-3
6.3	Transmission Specifications And Maintenance Information	6-3
6.4	Transmission Replacement	6-3
6.5	Torque Convertor Diaphragm	6-6
6.6	Troubleshooting	6-7
Section 7		
Engine		**7-1**
7.1	Introduction - John Deere	7-2
7.2	Introduction - Perkins	7-4
7.3	Introduction - Cummins	7-6
7.4	Engine Cooling System	7-8
7.5	Engine Electrical System	7-10
7.6	Fuel System	7-10
7.7	Engine Exhaust System	7-12
7.8	Air Cleaner Assembly	7-13
7.9	Engine Replacement	7-14
7.10	Troubleshooting	7-17
Section 8		
Hydraulic System		**8-1**
8.1	Hydraulic Component Terminology	8-2
8.2	Safety Information	8-3
8.3	Hydraulic Pressure Diagnosis	8-3
8.4	Hydraulic Circuits	8-4
8.5	Hydraulic Reservoir	8-13
8.6	Implement Pump	8-14
8.7	Control Valves	8-15
8.8	Hydraulic Cylinders	8-21
Section 9		
Electrical System		**9-1**
9.1	Electrical Component Terminology	9-3
9.2	Specifications	9-6
9.3	Safety Information	9-6
9.4	Fuses and Relays	9-6
9.5	Electrical System Schematics	9-10
9.6	Circuit Breakdowns	9-22

Section	Subject	Page
9.7	Engine Start Circuit	9-26
9.8	Window Wiper/Washer Windshield Wiper Motor	9-28
9.9	Cab Heater and Fan	9-30
9.10	Solenoids, Sensors and Senders	9-30
9.11	Display Monitor and Gauges	9-37
9.12	Dash Switches	9-38
9.13	Troubleshooting - John Deere	9-40
9.14	Engine Indicator Lamps - Perkins	9-42
9.15	SAE Diagnostic Trouble Codes and Fault Codes - Cummins	9-43

Section	Subject	Page

Section 1
Safety Practices

Contents

PARAGRAPH		TITLE	PAGE
1.1	**Introduction**		**1-2**
1.2	**Disclaimer**		**1-2**
1.3	**Operation & Safety Manual**		**1-2**
1.4	**Do Not Operate Tags**		**1-2**
1.5	**Safety Information**		**1-2**
1.5.1		Safety Alert System and Signal Words	1-2
1.6	**Safety Instructions**		**1-3**
1.6.1		Personal Hazards	1-3
1.6.2		Equipment Hazards	1-3
1.6.3		General Hazards	1-3
1.6.4		Operational Hazards	1-4
1.7	**Safety Decals**		**1-4**

1.1 INTRODUCTION

This service manual provides general directions for accomplishing service and repair procedures. Following the procedures in this manual will help assure safety and equipment reliability.

Read, understand and follow the information in this manual, and obey all locally approved safety practices, procedures, rules, codes, regulations and laws.

These instructions cannot cover all details or variations in the equipment, procedures, or processes described, nor provide directions for meeting every possible contingency during operation, maintenance, or testing. When additional information is desired consult the local distributor.

Many factors contribute to unsafe conditions: carelessness, fatigue, overload, inattentiveness, unfamiliarity, even drugs and alcohol, among others. For optimal safety, encourage everyone to think, and to act, safely.

Appropriate service methods and proper repair procedures are essential for the safety of the individual doing the work, for the safety of the operator, and for the safe, reliable operation of the machine. All references to the right side, left side, front and rear are given from the operator's seat looking in a forward direction.

Supplementary information is available from JLG in the form of Service Bulletins, Service Campaigns, Service Training Schools, the JLG website, other literature, and through updates to the manual itself.

1.2 DISCLAIMER

All information in this manual is based on the latest product information available at the time of publication. JLG reserves the right to make changes and improvements to its products, and to discontinue the manufacture of any product, at its discretion at any time without public notice or obligation.

1.3 OPERATION & SAFETY MANUAL

The mechanic must not operate the machine until the Operation & Safety Manual has been read & understood, training has been accomplished and operation of the machine has been completed under the supervision of an experienced and qualified operator.

An Operation & Safety Manual is supplied with each machine and must be kept in the manual holder located in the cab. In the event that the Operation & Safety Manual is missing, consult the local distributor before proceeding.

1.4 DO NOT OPERATE TAGS

Place Do Not Operate Tags on the ignition key switch and the steering wheel before attempting to perform any service or maintenance. Remove key and disconnect battery leads.

1.5 SAFETY INFORMATION

To avoid possible death or injury, carefully read, understand and comply with all safety messages.

In the event of an accident, know where to obtain medical assistance and how to use a first-aid kit and fire extinguisher/fire suppression system. Keep emergency telephone numbers (fire department, ambulance, rescue squad/paramedics, police department, etc.) nearby. If working alone, check with another person routinely to help assure personal safety.

1.5.1 Safety Alert System and Signal Words

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

1.6 SAFETY INSTRUCTIONS

Following are general safety statements to consider ***before*** performing maintenance procedures on the telehandler. Additional statements related to specific tasks and procedures are located throughout this manual and are listed prior to any work instructions to provide safety information before the potential of a hazard occurs.

For all safety messages, carefully read, understand and follow the instructions ***before*** proceeding.

1.6.1 Personal Hazards

PERSONAL SAFETY GEAR: Wear all the protective clothing and personal safety gear necessary to perform the job safely. This might include heavy gloves, safety glasses or goggles, filter mask or respirator, safety shoes or a hard hat.

LIFTING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist.

1.6.2 Equipment Hazards

LIFTING OF EQUIPMENT: Before using any lifting equipment (chains, slings, brackets, hooks, etc.), verify that it is of the proper capacity, in good working order, and is properly attached.

NEVER stand or otherwise become positioned under a suspended load or under raised equipment. The load or equipment could fall or tip.

DO NOT use a hoist, jack or jack stands only to support equipment. Always support equipment with the proper capacity blocks or stands properly rated for the load.

HAND TOOLS: Always use the proper tool for the job; keep tools clean and in good working order, and use special service tools only as recommended.

1.6.3 General Hazards

SOLVENTS: Only use approved solvents that are known to be safe for use.

HOUSEKEEPING: Keep the work area and operator's cab clean, and remove all hazards (debris, oil, tools, etc.).

FIRST AID: Immediately clean, dress and report all injuries (cuts, abrasions, burns, etc.), no matter how minor the injury may seem. Know the location of a First Aid Kit, and know how to use it.

CLEANLINESS: Wear eye protection, and clean all components with a high-pressure or steam cleaner before attempting service.

When removing hydraulic components, plug hose ends and connections to prevent excess leakage and contamination. Place a suitable catch basin beneath the machine to capture fluid run-off.

It is good practice to avoid pressure-washing electrical/ electronic components. In the event pressure-washing the machine is needed, ensure the machine is shut down before pressure-washing. Should pressure-washing be utilized to wash areas containing electrical/electronic components, JLG recommends a maximum pressure of 750 psi (52 bar) at a minimum distance of 12 in. (30,5 cm) away from these components. If electrical/electronic components are sprayed, spraying must not be direct and for brief time periods to avoid heavy saturation,

Check and obey all Federal, State and/or Local regulations regarding waste storage, disposal and recycling.

1.6.4 Operational Hazards

ENGINE: Stop the engine before performing any service unless specifically instructed otherwise.

VENTILATION: Avoid prolonged engine operation in enclosed areas without adequate ventilation.

SOFT SURFACES AND SLOPES: **NEVER** work on a machine that is parked on a soft surface or slope. The machine must be on a hard level surface, with the wheels blocked before performing any service.

FLUID TEMPERATURE: **NEVER** work on a machine when the engine, cooling or hydraulic systems are hot. Hot components and fluids can cause severe burns. Allow systems to cool before proceeding.

FLUID PRESSURE: Before loosening any hydraulic or diesel fuel component, hose or tube, turn the engine OFF. Wear heavy, protective gloves and eye protection. **NEVER** check for leaks using any part of your body; use a piece of cardboard or wood instead. If injured, seek medical attention immediately. Diesel fluid leaking under pressure can explode. Hydraulic fluid and diesel fuel leaking under pressure can penetrate the skin, cause infection, gangrene and other serious personal injury.

Relieve all pressure before disconnecting any component, part, line or hose. Slowly loosen parts and allow release of residual pressure before removing any part or component. Before starting the engine or applying pressure, use components, parts, hoses and pipes that are in good condition, connected properly and are tightened to the proper torque. Capture fluid in an appropriate container and dispose of in accordance with prevailing environmental regulations.

RADIATOR CAP: The cooling system is under pressure, and escaping coolant can cause severe burns and eye injury. To prevent personal injury, NEVER remove the radiator cap while the cooling system is hot. Wear safety glasses. Turn the radiator cap to the first stop and allow pressure to escape before removing the cap completely. Failure to follow the safety practices could result in death or serious injury.

FLUID FLAMABILTITY: **DO NOT** service the fuel or hydraulic systems near an open flame, sparks or smoking materials.

NEVER drain or store fluids in an open container. Engine fuel and hydraulic fluid are flammable and can cause a fire and/or explosion.

DO NOT mix gasoline or alcohol with diesel fuel. The mixture can cause an explosion.

PRESSURE TESTING: When conducting any test, only use test equipment that is correctly calibrated and in good condition. Use the correct equipment in the proper manner, and make changes or repairs as indicated by the test procedure to achieve the desired result.

LEAVING MACHINE: Lower the forks or attachment to the ground before leaving the machine.

TIRES: Always keep tires inflated to the proper pressure to help prevent tipover. **DO NOT** over-inflate tires.

NEVER use mismatched tire types, sizes or ply ratings. Always use matched sets according to machine specifications.

MAJOR COMPONENTS: Never alter, remove, or substitute any items such as counterweights, tires, batteries or other items that may reduce or affect the overall weight or stability of the machine.

BATTERY: DO NOT charge a frozen battery.Charging a frozen battery may cause it to explode. Allow the battery to thaw before jump-starting or connecting a battery charger.

1.7 SAFETY DECALS

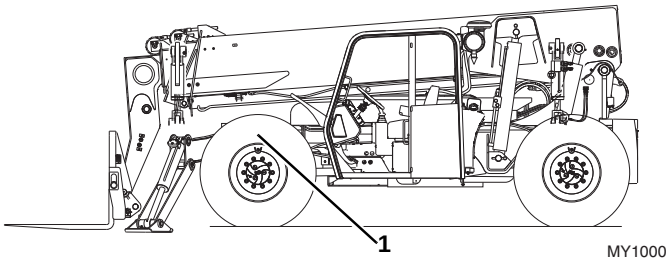
Check that all safety decals are present and readable on the machine. Refer to the Operation & Safety Manual supplied with machine for information.

Section 2
General Information and Specifications

Contents

PARAGRAPH		TITLE	PAGE
2.1		**Replacement Parts and Warranty Information**	**2-2**
2.2		**Torque Charts**	**2-3**
	2.2.1	SAE Fastener Torque Chart	2-3
	2.2.2	Metric Fastener Torque Chart	2-7
	2.2.3	Hydraulic Hose Torque Chart	2-10
2.3		**Specifications**	**2-11**
	2.3.1	Travel Speeds	2-11
	2.3.2	Hydraulic Cylinder Performance	2-11
	2.3.3	Electrical System	2-12
	2.3.4	Engine Performance Specifications - John Deere	2-12
	2.3.5	Engine Performance Specifications - Perkins	2-12
	2.3.6	Engine Performance Specifications - Cummins	2-13
2.4		**Fluid and Lubricant Capacities**	**2-15**
2.5		**Service and Maintenance Schedules**	**2-17**
	2.5.1	10, 1st 50 & 50 Hour	2-17
	2.5.2	1st 250, 250 & 500 Hour	2-18
	2.5.3	1000 & 1500 Hour	2-19
2.6		**Lubrication Schedules**	**2-20**

2.1 REPLACEMENT PARTS AND WARRANTY INFORMATION



Before ordering parts or initiating service inquiries, make note of the machine serial number. The machine serial number plate (**1**) is located as indicated in the figure.

Note: *The replacement of any part on this machine with any other than **JLG** authorized replacement parts can adversely affect the performance, durability, or safety of the machine, and will void the warranty. **JLG** disclaims liability for any claims or damages, whether regarding property damage, personal injury or death arising out of the use of unauthorized replacement parts.*

A warranty registration form must be filled out by the **JLG** distributor, signed by the purchaser and returned to **JLG** when the machine is sold and/or put into use.

Registration activates the warranty period and helps to assure that warranty claims are promptly processed. To guarantee full warranty service, verify that the distributor has returned the business reply card of the warranty registration form to **JLG**.

2.2 TORQUE CHARTS

2.2.1 SAE Fastener Torque Chart

				Values for Zinc Yellow Chromate Fasteners								
				SAE GRADE 5 BOLTS & GRADE 2 NUTS								
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140		Torque Loctite® 262™ OR Vibra-TITE™ 131	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7				
	48	0.1120	0.00661	420	9	1.0	7	0.8				
6	32	0.1380	0.00909	580	16	1.8	12	1.4				
	40	0.1380	0.01015	610	18	2.0	13	1.5				
8	32	0.1640	0.01400	900	30	3.4	22	2.5				
	36	0.1640	0.01474	940	31	3.5	23	2.6				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5				
	32	0.1900	0.02000	1285	49	5.5	36	4				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207
3/4	10	0.7500	0.3340	21300	260	353	200	271	285	388	240	325
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER

REFERENCE JLG ANEROBIC THREAD LOCKING COMPOUND			
JLG P/N	Loctite® P/N	ND Industries P/N	Description
0100011	242™	Vibra-TITE™ 121	Medium Strength (Blue)
0100019	271™	Vibra-TITE™ 140	High Strength (Red)
0100071	262™	Vibra-TITE™ 131	Medium - High Strength (Red)

MY4650J

2.2.1 SAE Fastener Torque Chart (Continued)

				Values for Zinc Yellow Chromate Fasteners						
				SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K= 0.20		Torque Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 K=.18		Torque Loctite® 262™ OR Vibra-TITE™ 131 K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	43	5				
10	24	0.1900	0.01750	1580	60	7				
	32	0.1900	0.02000	1800	68	8				
1/4	20	0.2500	0.0318	2860	143	16	129	15		
	28	0.2500	0.0364	3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m
5/16	18	0.3125	0.0524	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3555	4835	3200	4350	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER

MY4660J

2.2.1 SAE Fastener Torque Chart (Continued)

				SOCKET HEAD CAP SCREWS						
				Magni Coating*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K = .17		Torque Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85® K=0.16		Torque Loctite® 262™ OR Vibra-TITE™ 131 K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	410	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

MY4670J

2.2.1 SAE Fastener Torque Chart (Continued)

				SOCKET HEAD CAP SCREWS						
				Zinc Yellow Chromate Fasteners*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K = .20		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85® K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	143	16	129	15		
	28	0.2500	0.0364	3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	860	1170	775	1055	645	875
	12	1.0000	0.6630	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3555	4835	3200	4350	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

MY4680J

2.2.2 Metric Fastener Torque Chart

			Values for Zinc Yellow Chromate Fasteners				
			CLASS 8.8 METRIC BOLTS CLASS 8 METRIC NUTS				
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™)	Torque (Lub)	Torque Loctite® 262™ OR Vibra-TITE™ 131	Torque Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140
		Sq mm	KN	[N.m]	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8
6	1	20.10	8.74	11	7.9	9.4	12
7	1	28.90	12.6	18	13	16	19
8	1.25	36.60	15.9	26	19	23	28
10	1.5	58.00	25.2	50	38	45	55
12	1.75	84.30	36.7	88	66	79	97
14	2	115	50.0	140	105	126	154
16	2	157	68.3	219	164	197	241
18	2.5	192	83.5	301	226	271	331
20	2.5	245	106.5	426	320	383	469
22	2.5	303	132.0	581	436	523	639
24	3	353	153.5	737	553	663	811
27	3	459	199.5	1080	810	970	1130
30	3.5	561	244.0	1460	1100	1320	1530
33	3.5	694	302.0	1990	1490	1790	2090
36	4	817	355.5	2560	1920	2300	2690
42	4.5	1120	487.0	4090	3070	3680	4290

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

MY4690J

2.2.2 Metric Fastener Torque Chart (Continued)

			Values for Zinc Yellow Chromate Fasteners CLASS 10.9 METRIC BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M3 - M5*			
Size	PITCH	Tensile Stress Area	Clamp Load	Torque Dry or Loctite® 263™ K = 0.20	Torque Lube OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 K= 0.18	Torque Loctite® 262™ OR Vibra-TITE™ 131 K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5			
7	1	28.90	18.0	25.2	22.7	18.9
8	1.25	36.60	22.8	36.5	32.8	27.4
10	1.5	58.00	36.1	70	65	55
12	1.75	84.30	52.5	125	115	95
14	2	115	71.6	200	180	150
16	2	157	97.8	315	280	235
18	2.5	192	119.5	430	385	325
20	2.5	245	152.5	610	550	460
22	2.5	303	189.0	830	750	625
24	3	353	222.0	1065	960	800
27	3	459	286.0	1545	1390	1160
30	3.5	561	349.5	2095	1885	1575
33	3.5	694	432.5	2855	2570	2140
36	4	817	509.0	3665	3300	2750
42	4.5	1120	698.0	5865	5275	4395

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

MY4700J

2.2.2 Metric Fastener Torque Chart (Continued)

			Magni Coating*			
			CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*			
Size	PITCH	Tensile Stress Area	Clamp Load See Note 4	Torque Dry or Loctite® 263™ K = .17	Torque Lube OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 K = .16	Torque Loctite® 262™ OR Vibra-TITE™ 131 K = .15
		Sq mm	kN	[N.m]	[N.m]	[N.m]
3	0.5	5.03				
3.5	0.6	6.78				
4	0.7	8.78				
5	0.8	14.20				
6	1	20.10	12.5	13	12	11
7	1	28.90	18.0	21	20	19
8	1.25	36.60	22.8	31	29	27
10	1.5	58.00	36.1	61	58	54
12	1.75	84.30	52.5	105	100	95
14	2	115	71.6	170	160	150
16	2	157	97.8	265	250	235
18	2.5	192	119.5	365	345	325
20	2.5	245	152.5	520	490	460
22	2.5	303	189.0	705	665	625
24	3	353	220.0	900	845	790
27	3	459	286.0	1315	1235	1160
30	3.5	561	349.5	1780	1680	1575
33	3.5	694	432.5	2425	2285	2140
36	4	817	509.0	3115	2930	2750
42	4.5	1120	698.0	4985	4690	4395

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

MY4710J

2.2.3 Hydraulic Hose Torque Chart

O-Ring Face Seal & JIC Torque Chart

Size	ORFS	JIC	Flats Method
4	13 lb-ft (18 Nm)	13 lb-ft (18 Nm)	1.5 to 1.75
6	23 lb-ft (31 Nm)	23 lb-ft (31 Nm)	1 to 1.5
8	40 lb-ft (54 Nm)	40 lb-ft (54 Nm)	1.5 to 1.75
10	60 lb-ft (81 Nm)	60 lb-ft (81 Nm)	1.5 to 1.75
12	74 lb-ft (100 Nm)	85 lb-ft (115 Nm)	1.0 to 1.5
16	115 lb-ft (156 Nm)	115 lb-ft (156 Nm)	0.75 to 1.0
20	170 lb-ft (230 Nm)	170 lb-ft (230 Nm)	0.75 to 1.0
24	200 lb-ft (271 Nm)	200 lb-ft (271 Nm)	0.75 to 1.0
32	N/A	270 lb-ft (366 Nm)	0.75 to 1.0

Note: *By definition the "Flats Method" will contain some variance. Use the "Flats Method" only when accessibility with a torque wrench is not possible.*

Torque Wrench:

1. Identify the appropriate application and refer to the above chart for the correct torque value.
2. If equipped, lubricate o-ring with hydraulic oil. Hand tighten the swivel nut until no lateral movement of the swivel nut can be detected. Average hand torque is 3 lb-ft (4 Nm).
3. Use the double wrench method while tightening to avoid hose twist.
4. Torque wrench must be held at the center of the grip. Apply constant force until it clicks.
5. After the connection has been properly tightened, mark a straight line across the connecting parts indicating that the connection has been properly tightened.

Flats Method:

1. If equipped, lubricate o-ring with hydraulic oil. Hand tighten the swivel nut until no lateral movement of the swivel nut can be detected. Average hand torque is 3 lb-ft (4 Nm).
2. Mark a dot on one of the swivel nut flats and another dot in line on the hex of the adapter it's connecting to.
3. Use the double wrench method while tightening to avoid hose twist.
4. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots indicating that the connection has been properly tightened.

2.3 SPECIFICATIONS

2.3.1 Travel Speeds

FUNCTION	G10-55A	G12-55A
First Gear	3.4 mph (5,4 km/h)	3.5 mph (5,6 km/h)
Second Gear	6.1 mph (9,8 km/h)	6.3 mph (10,1 km/h)
Third Gear	13.8 mph (22,2 km/h)	14.1 mph (22,7 km/h)
Fourth Gear	20.0 mph (32,2 km/h)	20.4 mph (32,8 km/h)

2.3.2 Hydraulic Cylinder Performance

Note: *Machine with no attachment or load, engine at full throttle, hydraulic oil above 130° F (54° C) minimum, engine at operating temperature.*

FUNCTION	APPROXIMATE TIMES (seconds)	
	G10-55A	G12-55A
Boom Extend (Boom Level)	17.3	16.5
Boom Retract (Boom Level)	16.8	16.0
Boom Lift	14.6	15.8
Boom Lower	15.8	18.3
Attachment Tilt Forward	6.0	8.0
Attachment Tilt Rearward	7.1	6.4
Sway - Full Right to Left	10.4	9.8
Sway - Full Left to Right	12.2	10.0
Outrigger - Down	5.0	4.9
Outrigger - Up	4.1	4.1

2.3.3 Electrical System

Battery	
Type, Rating	12 BCI, Negative (-) Ground, Maintenance Free
Quantity	1
Reserve Capacity	1,000 Cold Cranking Amps @ 0° F (-18° C)
Group/Series	Group 31
Alternator	12V, 95 Amps

2.3.4 Engine Performance Specifications - John Deere

Description	G10-55A	G12-55A
Engine Make/Model	John Deere PE 4045HF275	John Deere PE 4045HF275
Displacement	276 in^3 (4,5 liters)	276 in^3 (4,5 liters)
Low Idle	900 rpm	900 rpm
High Idle	2,400 to 2,650 rpm	2,400 to 2,650 rpm
Horsepower	125 HP (93 kW) @ 2400 rpm	140 HP (104 kW) @ 2400 rpm
Peak Torque	341 lb-ft (483 Nm) @ 1400 rpm	367 lb-ft (497 Nm) @ 1400 rpm
Fuel Delivery	Fuel Injection	Fuel Injection
Average Fuel Consumption (depending on load/duty)	4.1 gal/hr (15.5 l/hr)	4.3 gal/hr (16.2 l/hr)
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements	Dry Type, Replaceable Primary and Safety Elements

2.3.5 Engine Performance Specifications - Perkins

Description	G10-55A	G12-55A
Engine Make/Model	Perkins 1104D - 125HP	Perkins 1104D - 142HP
Displacement	276 in^3 (4,5 liters)	276 in^3 (4,5 liters)
Low Idle	1000 rpm	900 rpm
High Idle	2,400 to 2,650 rpm	2,400 to 2,650 rpm
Horsepower	125 HP (93 kW) @ 2400 rpm	142 HP (104 kW) @ 2400 rpm
Peak Torque	Not Available at Publication	410 lb-ft (556 Nm) @ 1400 rpm
Fuel Delivery	Fuel Injection	Fuel Injection
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements	Dry Type, Replaceable Primary and Safety Elements

2.3.6 Engine Performance Specifications - Cummins

Description	G10-55A & G12-55A
Engine Make/Model	Cummins QSB - 130HP
Displacement	276 in^3 (4,5 liters)
Low Idle	900 rpm
High Idle	2,500 to 2,700 rpm
Horsepower	130 HP (97 kW) @ 2500 rpm
Peak Torque	459 lb-ft (622 Nm) @ 1500 rpm
Fuel Delivery	Fuel Injection
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements

2.3.7 Tires

Note: *Standard wheel lug nut torque is 350-400 lb-ft (475-542 Nm).*

Note: *Pressure for foam filled tires are for initial fill ONLY.*

a. G10-55A

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
14.00 x 24	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	65 psi (4,5 bar)
			Foam - Approx 720 lb (327 kg)	62 psi (4,3 bar)
14.00 x 24	G-3/L-3 Bias Ply Rock	12 Ply	Pneumatic	65 psi (4,5 bar)
			Foam - Approx 720 lb (327 kg)	62 psi (4,3 bar)
14.00 x 24	G-2/L-2 Radial	1 Star	Pneumatic	70 psi (4,8 bar)
			Foam - Approx 720 lb (327 kg)	70 psi (4,8 bar)
14.00 x 24			Solid - 1038 lb (470 kg)	
17.50 x 25	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	65 psi (4,5 bar)
			Foam - Approx 785 lb (356 kg)	51 psi (3,5 bar)
17.50 x 25	G-3/L-3 Bias Ply Rock	12 Ply	Pneumatic	65 psi (4,5 bar)
			Foam - Approx 785 lb (356 kg)	51 psi (3,5 bar)
17.50 x 25	G-2/L-2 Radial	1 Star	Pneumatic	70 psi (4,8 bar)
			Foam - Approx 785 lb (356 kg)	73 psi (5,0 bar)
400/75-28	Duraforce	16 Ply	Pneumatic	76 psi (5,2 bar)
			Foam - Approx 570 lb (259 kg)	73 psi (5,0 bar)

b. G12-55A

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
17.50 x 25	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	65 psi (4,5 bar)
			Foam - Approx 785 lb (356 kg)	51 psi (3,5 bar)
17.50 x 25	G-3/L-3 Bias Ply Rock	12 Ply	Pneumatic	65 psi (4,5 bar)
			Foam - Approx 785 lb (356 kg)	51 psi (3,5 bar)
17.50 x 25	G-2/L-2 Radial	1 Star	Pneumatic	70 psi (4,8 bar)
			Foam - Approx 785 lb (356 kg)	73 psi (5,0 bar)
400/75-28	Duraforce	16 Ply	Pneumatic	76 psi (5,2 bar)
			Foam - Approx 570 lb (259 kg)	73 psi (5,0 bar)

2.4 FLUID AND LUBRICANT CAPACITIES

Engine Crankcase Oil

Capacity with Filter Change	
John Deere (G10-55A)	14.3 quarts (13,5 liters)
John Deere (G12-55A)	15.8 quarts (15,0 liters)
Perkins	7 quarts (6,5 liters)
Cummins	13.5 quarts (12,8 liters)
Type of Oil	
0° to 104° F (-20° to 40° C)	15W-40 CH
-40° to 0° F (-40° to 20° C)	0W-40 CH

Fuel Tank

Capacity	38 gallons (144 liters)
Type of Fuel	
0° to 104° F (-20° to 40° C)	#2 Diesel
-40° to 0° F (-40° to 20° C)	#1 Diesel
Anti-Gel Fluid	
-40° to 0° F (-40° to 20° C)	16 oz (0,5 liters)

Cooling System

System Capacity	
John Deere	20.5 quarts (19,4 liters)
Perkins	22.25 quarts (21 liters)
Cummins	
No Heater	22.8 quarts (21,6 liters)
With Heater	24.3 quart (23 liters)
Overflow Bottle Capacity	
Before S/N 0160039451 excluding 0160039394 & 0160039397	3 quarts (2,8 liters)
S/N 0160039451 & After including 0160039394 & 0160039397	2.5 quarts (2,4 liters)
Type of Coolant	
0° to 104° F (-20° to 40° C)	50/50 ethylene glycol & water
-40° to 0° F (-40° to 20° C)	60/40 ethylene glycol & water
Coolant Conditioner	
Before S/N 0160039451 excluding 0160039394 & 0160039397	0.5 quarts (0,47 liters)
S/N 0160039451 & After including 0160039394 & 0160039397	Not Required

Hydraulic System

System Capacity	
G10-55A	63 gallons (238 liters)
G12-55A	65 gallons (246 liters)
Reservoir Capacity	38 gallons (144 liters)
Type of Fluid	
0° to 104° F (-20° to 40° C)	Mobilfluid 424® Tractor Hydraulic Fluid
-40° to 0° F (-40° to 20° C)	Exon Univis HVI All Season Hyd Fluid
Auxiliary Hydraulic Circuit Max Flow	10 gpm (37,9 lpm)

Transmission

Capacity with Filter Change	4 gallons (16 liters)
Type of Fluid	
0° to 104° F (-20° to 40° C)	Mobilfluid 424® Tractor Hydraulic Fluid
-40° to 0° F (-40° to 20° C)	Mobilfluid LT® Hydraulic Fluid (75W-80)

Transfer Case

Capacity	1.5 quarts (1,4 liters)
Type of Fluid	
0° to 104° F (-20° to 40° C)	Mobilfluid 424® Tractor Hydraulic Fluid
-40° to 0° F (-40° to 20° C)	Mobilfluid LT® Hydraulic Fluid (75W-80)

Axles

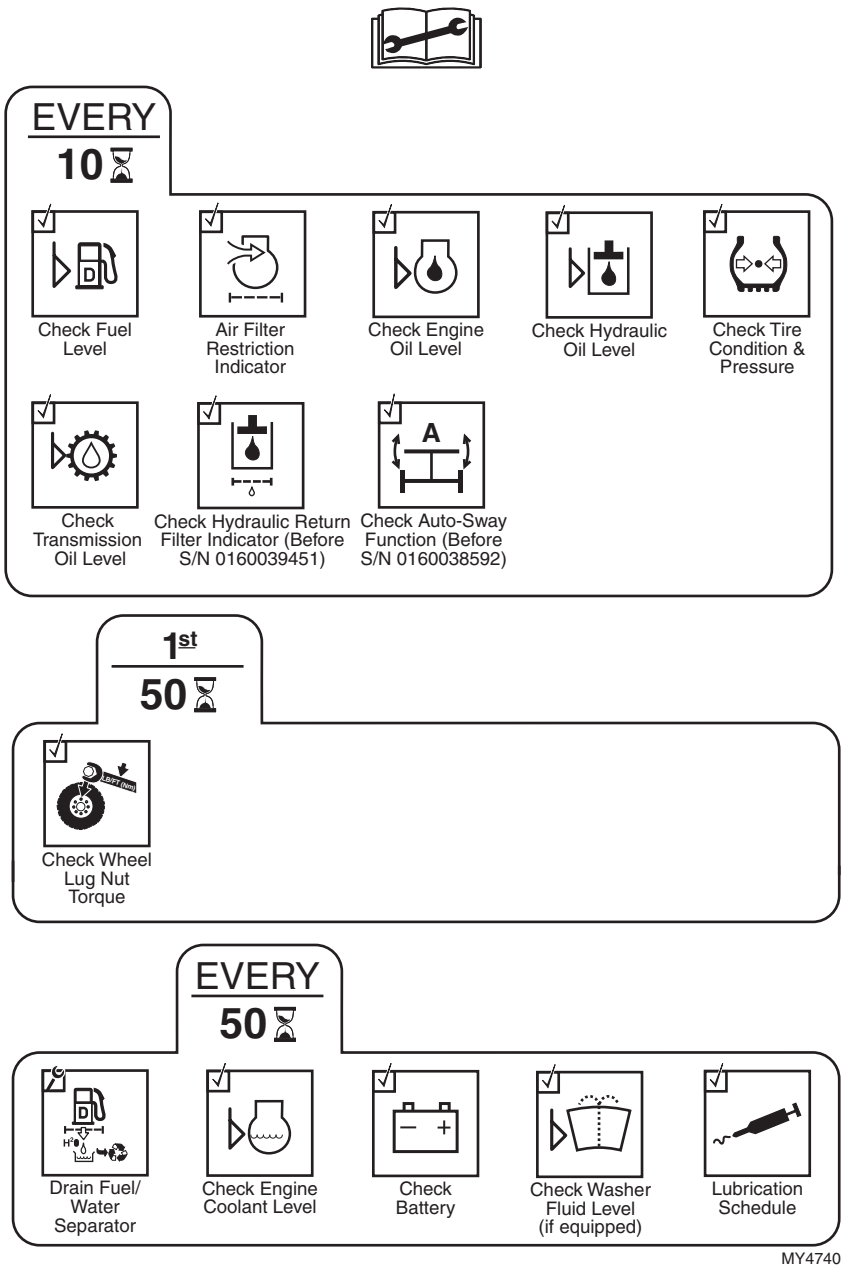
Differential Housing Capacity	
Front	15.8 quarts (15 liters)
Rear	16.9 quarts (16 liters)
Wheel End Capacity	2 quarts (1,9 liters)
Type of Fluid	
0° to 104° F (-20° to 40° C)	Mobilfluid 424® Tractor Hydraulic Fluid
-40° to 0° F (-40° to 20° C)	Mobilfluid LT® Hydraulic Fluid (75W-80)

Air Conditioning System (if equipped)

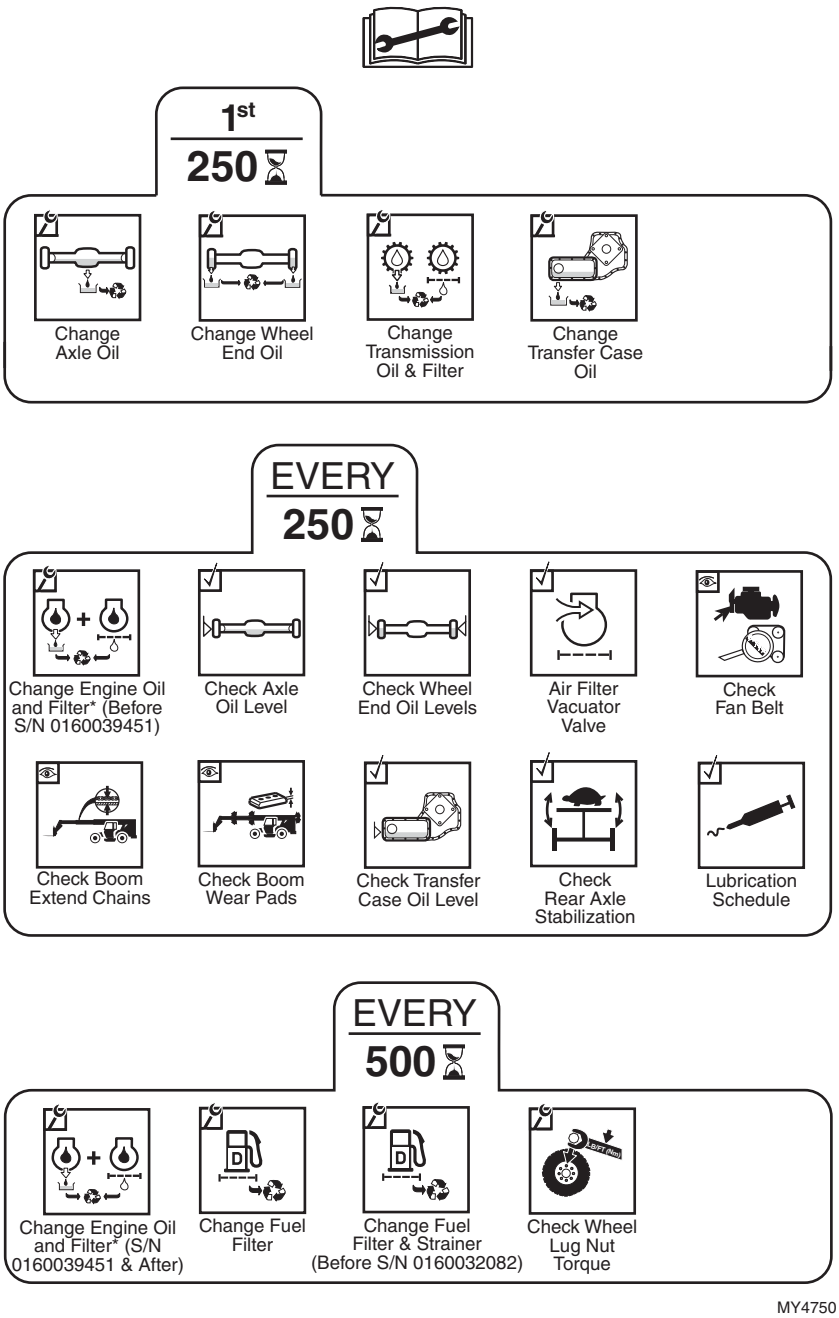
System Capacity	2.5 lb (1134 g)
Type of Fluid	Refrigerant R-134a - Tetrafluorethane

2.5 SERVICE AND MAINTENANCE SCHEDULES

2.5.1 10, 1st 50 & 50 Hour

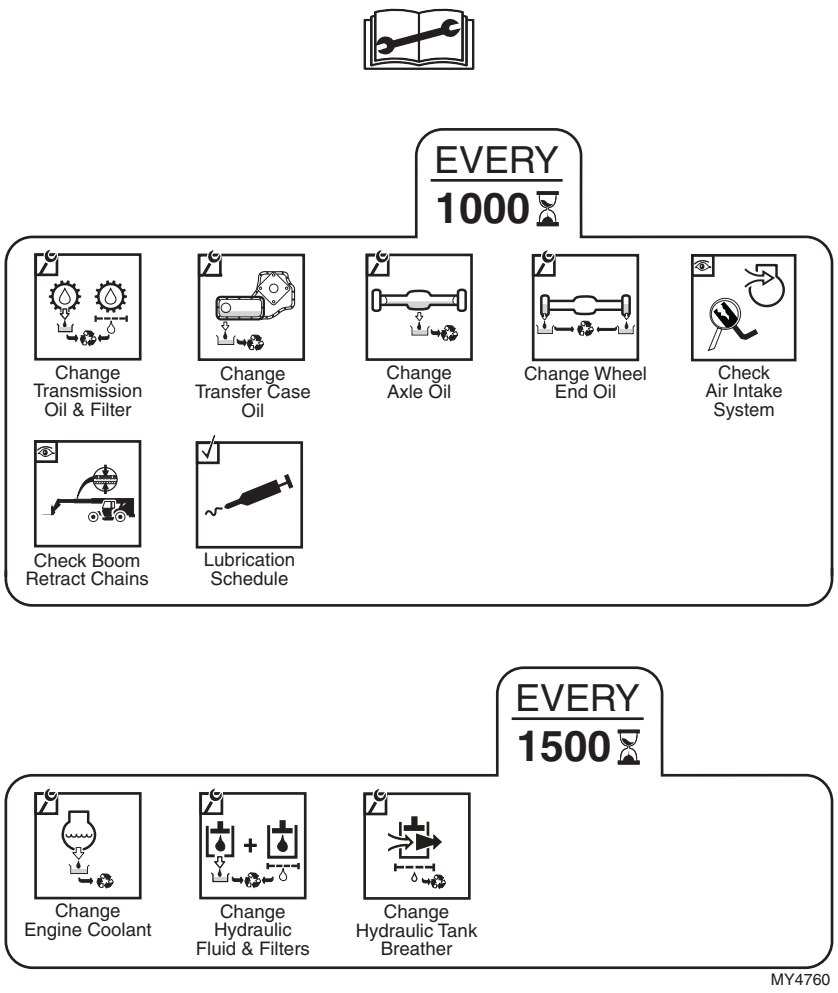


2.5.2 1st 250, 250 & 500 Hour



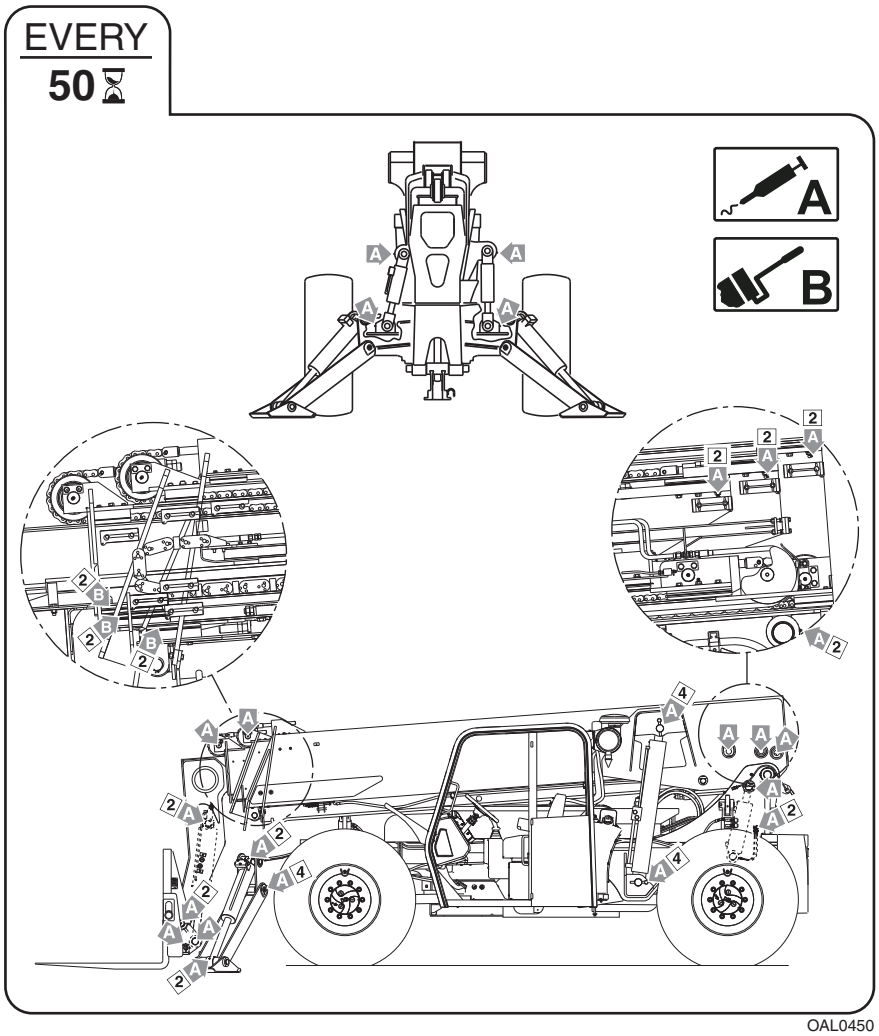
Note: *Engine oil & filter service interval can be extended. See Engine Manual for details.*

2.5.3 1000 & 1500 Hour



2.6 LUBRICATION SCHEDULES

a. 50 Hour



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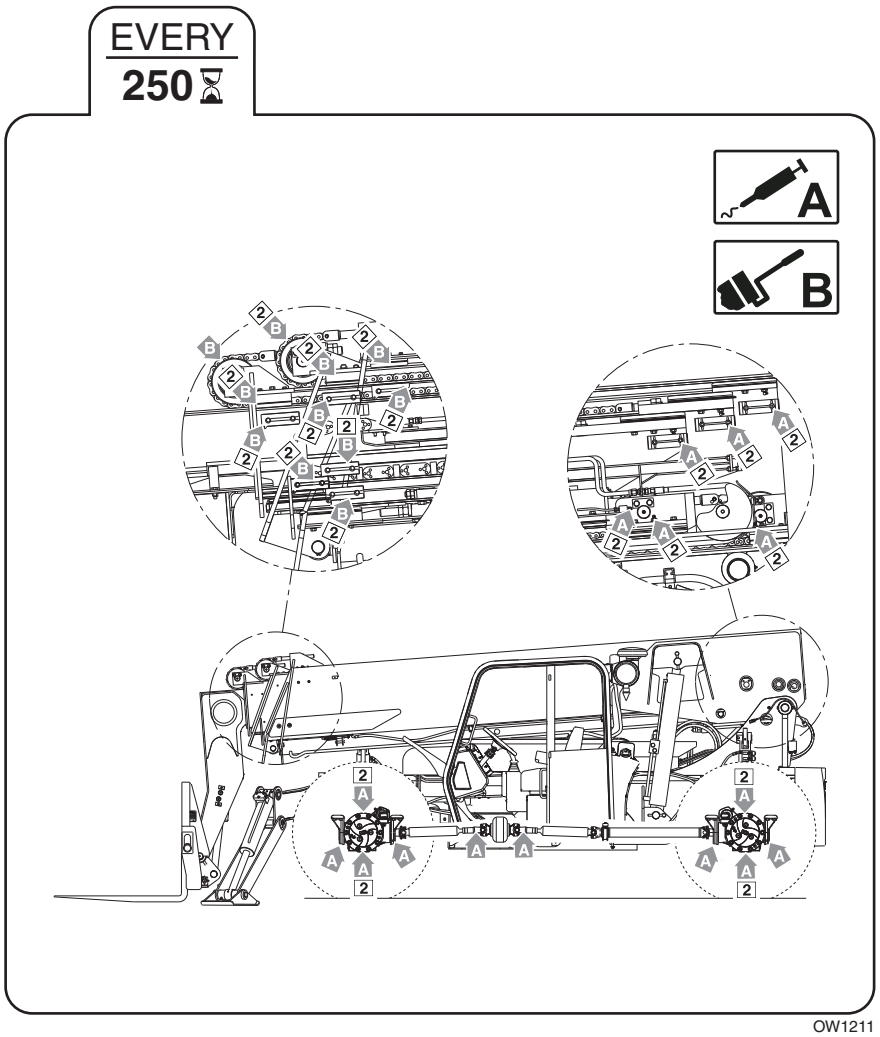
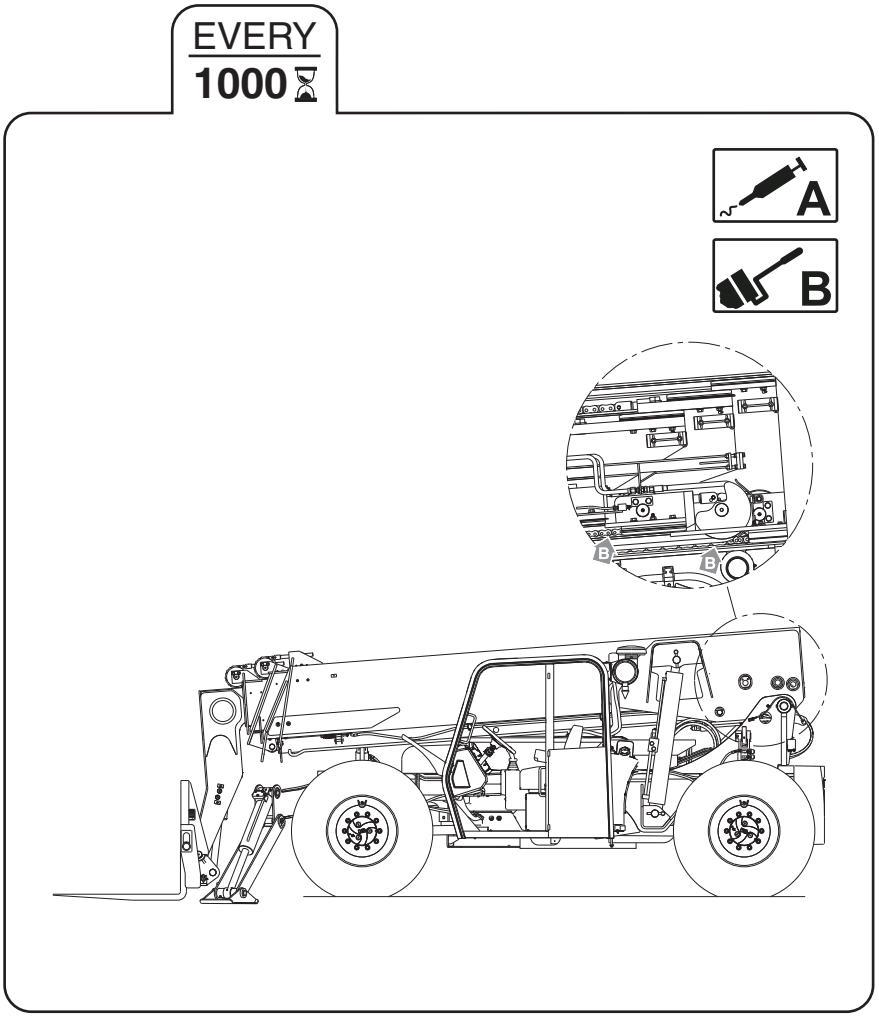
b. 250 Hour



c. 1000 Hour



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Section 3
Boom

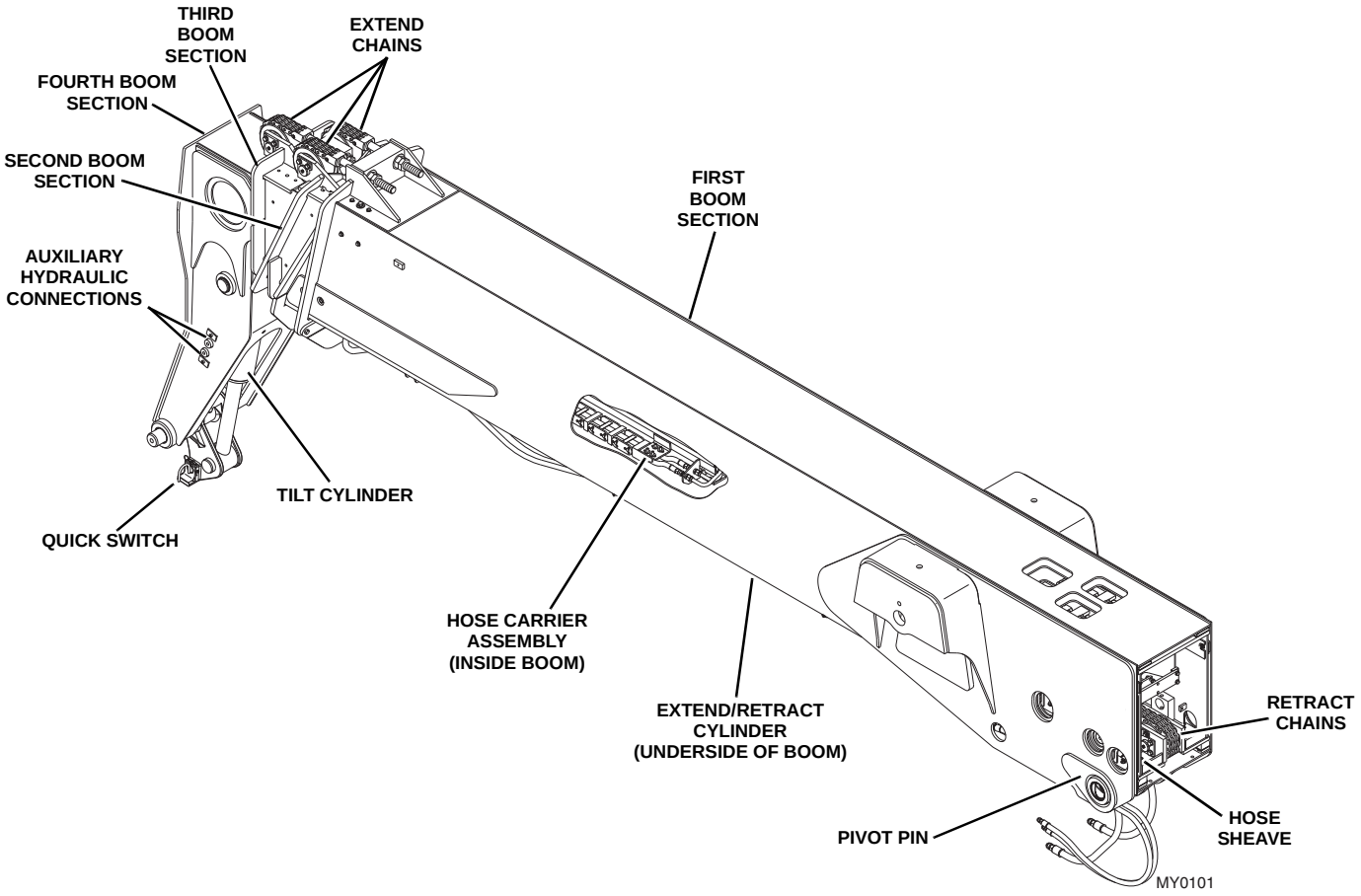
Contents

PARAGRAPH	TITLE	PAGE
3.1	**Boom System Component Terminology**	**3-3**
3.2	**Boom System - Four Section**	**3-4**
3.2.1	Boom System Operation	3-4
3.3	**Boom Assembly Maintenance**	**3-4**
3.4	**Complete Boom Removal/Installation**	**3-5**
3.4.1	Complete Boom Removal	3-5
3.4.2	Complete Boom Installation	3-5
3.5	**Boom Section Removal/Installation**	**3-6**
3.5.1	Second, Third & Fourth Boom Section Removal	3-6
3.5.2	Third & Fourth Boom Section Removal	3-8
3.5.3	Fourth Boom Section Removal	3-9
3.5.4	Hose Carrier Removal	3-10
3.5.5	Fourth Boom Section Assembly	3-10
3.5.6	Hose Carrier Installation	3-11
3.5.7	Third Boom Section Assembly	3-12
3.5.8	Fourth Boom Section Installation	3-12
3.5.9	Second Boom Section Assembly	3-13
3.5.10	Third & Fourth Boom Section Installation	3-14
3.5.11	Second, Third and Fourth Boom Section Installation	3-15
3.6	**Extend/Retract Chain Removal/Installation**	**3-16**
3.6.1	Retract Chain Removal	3-16
3.6.2	Retract Chain Installation	3-17
3.6.3	Extend Chain Removal	3-17
3.6.4	Extend Chain Installation	3-18
3.7	**Boom Section Separation Adjustment**	**3-18**
3.8	**Hose Carrier Assembly Removal/Installation**	**3-20**
3.8.1	Hose Carrier Assembly Removal	3-20
3.8.2	Assembling the Hose Carrier Assembly	3-21
3.8.3	Hose Carrier-Assembly Installation	3-21
3.8.4	Boom Hose Adjustment	3-22
3.9	**Quick Switch Assembly**	**3-23**
3.9.1	Quick Switch Removal	3-23
3.9.2	Quick Switch Installation	3-23
3.9.3	Quick Switch Removal	3-23
3.9.4	Quick Switch Installation	3-23

3.10 Boom Head - Mounted Winch 3-24
3.10.1 Boom Head-Mounted Winch Removal 3-24
3.10.2 Boom Head-Mounted Winch Installation 3-24
3.11 Boom Wear Pads 3-24
3.11.1 Wear Pad Inspection 3-24
3.11.2 Wear Pad Installation and Lubrication 3-24
3.12 Boom Extend and Retract Chains 3-25
3.12.1 Boom Chain Inspection 3-25
3.12.2 Inspection Guidelines 3-26
3.12.3 Expose Chains for Inspection 3-28
3.12.4 Chain Lubrication 3-28
3.13 Forks 3-29
3.14 Troubleshooting 3-30

3.1 BOOM SYSTEM COMPONENT TERMINOLOGY

The following illustrations identify the components that are referred to throughout this section.



3.2 BOOM SYSTEM - FOUR SECTION

3.2.1 Boom System Operation

The four section boom consists of the first, second, third and fourth assemblies with double third and fourth section extend chains, a double third section retract chain and a single fourth section retract chain.

As the extend/retract cylinder, which is anchored at the front of the second boom section, and the rear of the first boom section begins to extend, it forces the second boom section out of the first boom section.

The boom sections are connected by extend and retract chains. These chains are routed around sheaves on the second and third boom sections. As the second section is forced out hydraulically, the third and fourth boom sections are pulled out by the extend chains.

As hydraulic pressure is applied to the retract port on the extend/retract cylinder, the second boom section is pulled back into the first boom section, and the retract chain pulls the third and fourth boom sections back into the second boom section.

This mechanical linkage formed by the chains and supporting hardware, extends and retracts the third and fourth boom sections at the same rate.

The boom section lifts and lowers via action of the lift/lower cylinder.

3.3 BOOM ASSEMBLY MAINTENANCE

These instructions provide the complete boom assembly removal and installation or the second, third and fourth boom sections removal and installation.

Before beginning, conduct a visual inspection of the machine and work area, and review the task about to be undertaken. Read, understand and follow these instructions.The boom assembly consists of the first, second and third section booms and supporting hardware.

Note: *Before removing the boom or boom section, the carriage or any other attachment must be removed from the quick switch.*

Before beginning, conduct a visual inspection of the machine and work area, and review the task about to be undertaken. Read, understand and follow these instructions.

During service of the boom, perform the following:

1. Check wear pads. (Refer to Section 3.11, “Boom Wear Pads.”)
2. Check hose sheaves and chain rollers.
3. Apply grease at all lubrication points (grease fittings). (Refer to Section 2.6, “Lubrication Schedules.”)
4. Check for proper operation by operating all boom functions through their full ranges of motion several times.

Depending on your particular circumstance, the following procedures explain the removal/installation of individual boom sections or removal/installation of the complete boom.

⚠ WARNING

NEVER weld or drill the boom unless approved in writing by the manufacturer. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling.

3.4 COMPLETE BOOM REMOVAL/ INSTALLATION

3.4.1 Complete Boom Removal

1. Remove any attachment from the quick switch assembly. Refer to the appropriate operation and safety manual.
2. Remove the quick switch assembly. Refer to *Section 3.9.1, "Quick Switch Removal."*
3. If equipped, remove the Boom Head Mounted Winch. Refer to *Section 3.10.1, "Boom Head-Mounted Winch Removal."*
4. Park the machine on a hard, level surface, level the machine, fully retract the boom, raise the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
5. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
6. Open the engine cover. Allow the system fluids to cool.
7. Properly disconnect the battery.
8. Support the front of the boom by placing a sling behind the boom head.
9. Label, disconnect and cap all hydraulic hoses for the extend/retract and tilt circuits. Cap all fittings and openings to keep dirt & debris from entering the hydraulic system.
10. Support the lift/lower cylinder on the left side of the machine. Remove the lock bolt and rod end pin. Lower the lift/lower cylinder onto the frame rails. Repeat this step for the right side lift/lower cylinder.
11. Support the compensation cylinder. Remove the lock bolt and rod end pin. Lower the compensation cylinder onto the frame rails.
12. Lower the boom to a level position and place a suitable support under the boom head. Reposition the slings to each end of the boom.
13. Remove the bolt securing the boom pivot pin. Pull out the boom pivot pin.
14. Lift the complete boom off machine and set on level ground or supports.

3.4.2 Complete Boom Installation

1. Park the machine on a hard, level surface, place the transmission control lever in (N) NEUTRAL, engage the park brake, chock the wheels and shut the engine OFF.
2. Using suitable slings, balance the boom assembly, lift and carefully guide the boom into place. Align the frame pivot bore with the boom assembly pivot bore.
3. Install the boom pivot pin.
4. With the sling still in place, install the compensation cylinder, pins and bolts.
5. With the sling still in place, install the rod end of the left lift/lower cylinder, pin and lock bolt. Repeat for the right side lift/lower cylinder.

Note: *Raising the boom up or down with the sling may be necessary so the boom, compensation and lift/lower cylinder bores can be aligned for easier pin installation.*

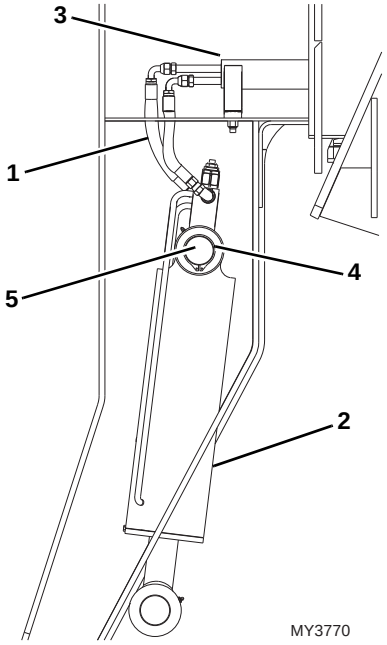
Note: *Grease the boom pivot bore, compensation cylinder rod ends, lift/lower cylinder rod end and pins before installing.*

6. Uncap and reconnect the previously labeled hydraulic hoses to the extend/retract cylinder.
7. Uncap and connect any remaining hydraulic fittings to their appropriate locations.
8. Recheck the wear pad gaps to ensure they meet the minimum gap requirement. Shim if necessary.
9. Ensure that the boom chains are properly adjusted. Refer to Section 3.7, "Boom Section Separation Adjustment."
10. Properly connect the battery.
11. Start the engine and operate all boom functions several times. Check for leaks, and check the hydraulic fluid level in the reservoir; add fluid if required.
12. Install the quick switch assembly. Refer to *Section 3.9.2, "Quick Switch Installation."*
13. If equipped, install the Boom Head Mounted Winch. Refer to *Section 3.10.2, "Boom Head-Mounted Winch Installation."*
14. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.
15. Close and secure the engine cover.
16. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.
17. Install the previously remove attachment to the quick switch assembly. Refer to the appropriate operation and safety manual.

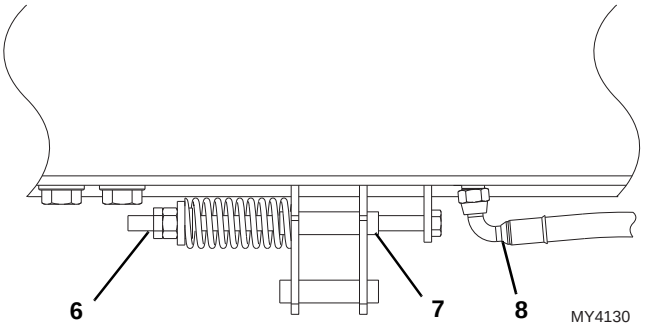
3.5 BOOM SECTION REMOVAL/ INSTALLATION

3.5.1 Second, Third & Fourth Boom Section Removal

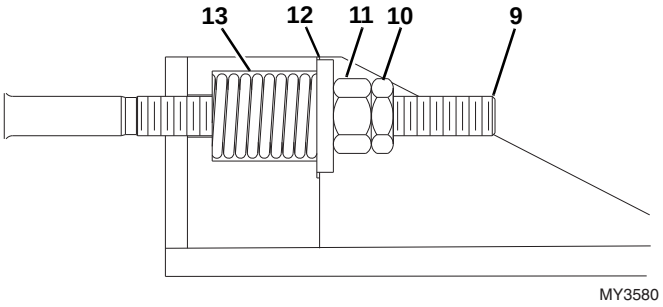
1. Remove any attachment from the quick switch assembly. Refer to the appropriate operation and safety manual.
2. Remove the quick switch assembly. Refer to *Section 3.9.1, "Quick Switch Removal."*
3. If equipped, remove the Boom Head Mounted Winch. Refer to *Section 3.10.1, "Boom Head-Mounted Winch Removal."*
4. Park the machine on a hard, level surface, level the machine, fully retract the boom, level the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
5. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
6. Open the engine cover. Allow the system fluids to cool.



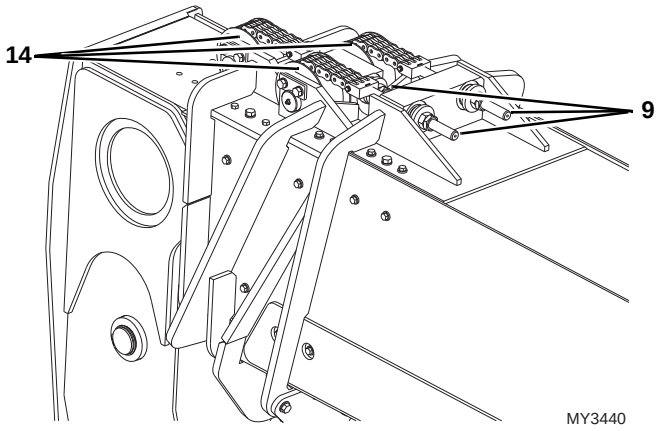
7. Label and remove both tilt cylinder hoses (**1**) between the tilt cylinder (**2**) and the hose carrier (**3**). Label, cap and plug the hose carrier tube ends and cylinder ports to prevent dirt and debris from entering the hydraulic system.
8. Using a suitable lifting device, secure the tilt cylinder barrel with a nylon strap.
9. Remove both retaining clips (**4**) from each side of the tilt cylinder mounting pin (**5**).
10. Remove the tilt cylinder mounting pin (**5**).
11. Lower tilt cylinder from the boom head.
12. Support the front of the boom by placing a sling behind the boom head.



13. Loosen the jam nut and lock nut (**6**) to release tension from the hoses on the hose take-up weldment (**7**).
14. Loosen the hydraulic hoses (**8**) and electrical cables if equipped on the hose take-up weldment (**7**). Plug the hose ends and tube ends to prevent dirt and debris from entering the hydraulic system.



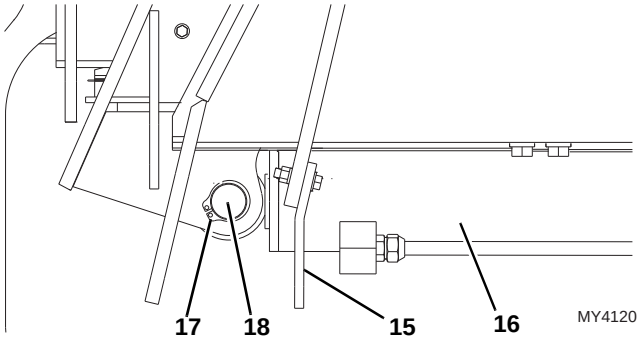
15. At the top front of the boom, measure and note the distance from the end of the three extend chain clevises (**9**) to the face of the lock nut (**10**).
16. Loosen and remove the lock nuts (**10**), adjusting nuts (**11**), washers (**12**) and springs (**13**) from the three extend chain clevises (**9**).



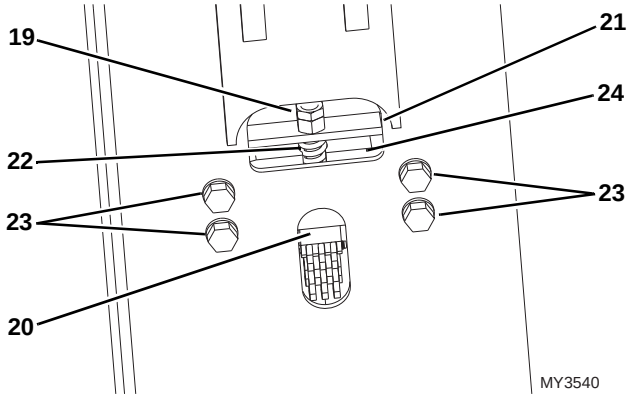
17. Pull the three extend chain clevises (**9**) off of each chain roller (**14**) and lay each assembly on the third and fourth boom sections respectively.

Note: *It may be necessary to remove the extend chain rollers to help in the removal of the top wear pads.*

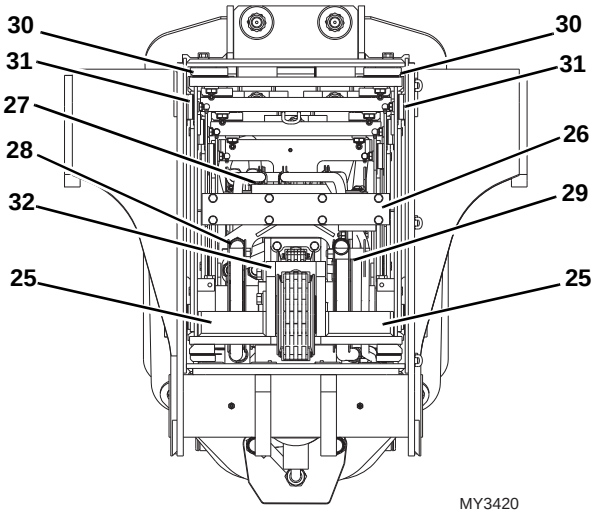
18. Verify all fittings, tubes and hoses are properly capped and /or plugged.
19. Extend the second boom section to access the retract chain adjusting block.



20. Remove the extend/retract cylinder support (**15**) from the front of the first boom section.
21. Support the extend/retract cylinder (**16**) with a suitable sling.
22. Remove the retaining clips (**17**) from each side of the extend/retract cylinder rod.
23. Remove the extend/retract cylinder rod mounting pin (**18**).
24. Lower the front of the extend/retract cylinder to a secured block on top of the frame. Do Not use the engine hood for support.



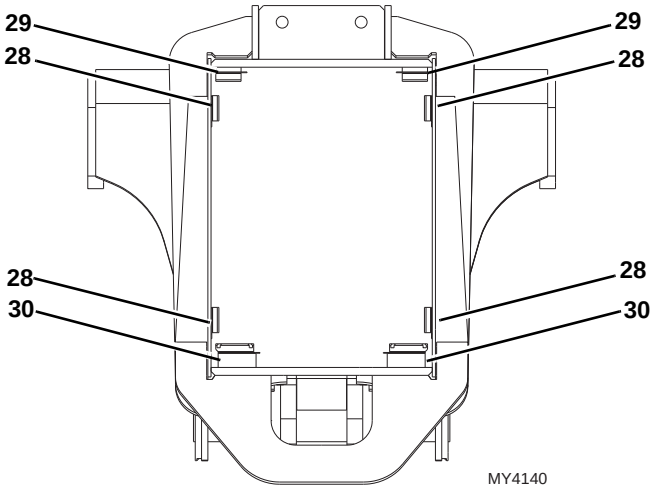
25. Remove the adjusting nut and lock nut (**19**), retract chain & clevis (**20**), spring stop (**21**) and spring (**22**). Loosen bolts (**23**) and adjusting block (**24**).
26. Properly disconnect the battery.



27. At the rear of the boom, remove both hose sheave covers (**25**).
28. Unbolt the hose carrier bracket (**26**) from the rear of the second boom section and the hose carrier.
29. Pull the hose carrier (**27**) back to gain access to the tilt hose (**28**) and the auxiliary hose (**29**) connections.
30. Disconnect the tilt hoses, auxiliary hoses and if equipped, the electrical connector at the rear of the hose carrier. Label, plug and cap all hydraulic connections to prevent dirt and debris from entering the hydraulic system.
31. Push hose carrier (**27**) as far forward as possible.

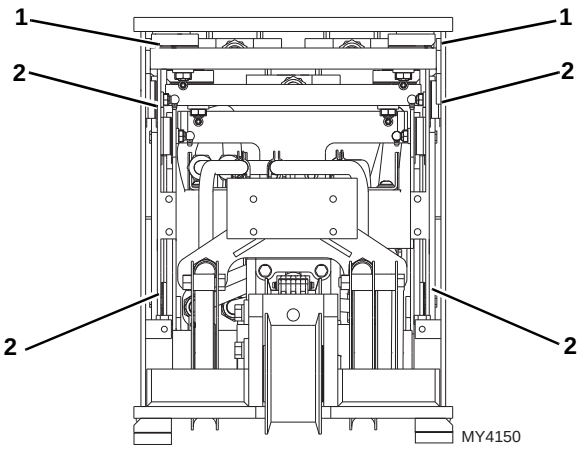
Note: *Tag each wear pad, spacer, shim and hardware from each location. Note the location of any grease fitting (if equipped) on each wear pad.*

32. Remove the top rear wear pads, spacers, shims and hardware (**30**) from the rear of the second boom section.
33. Remove the left (or right) side rear wear pad, spacer, shims and hardware (**31**) from the rear of the second boom section.
34. Pull each boom section slightly forward to relieve the tension in retract chain (**32**).
35. Remove the snap rings and pin connecting the rear retract chain (**32**) from the chain clevis at the rear of the boom. Allow chain to hang out over the rear of the boom.
36. Place a sling around the second boom section. With a suitable lifting device, slowly pull the second, third and fourth boom sections approximately 25% out of the first boom section.



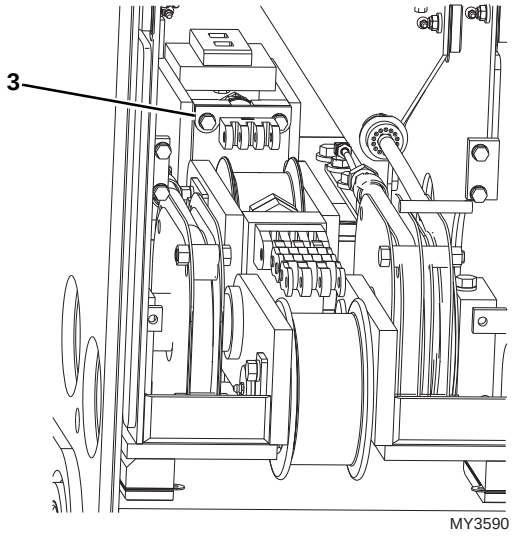
37. With the second, third and fourth boom section still connected to a suitable lifting device, remove all wear pads, spacers, shims, and hardware (**28**) from the front sides of the first boom section.
38. Remove both wear pads, spacers, shims, blocks and hardware (**29**) from the front top of the first boom section.
39. Remove both wear pads, spacers, shims and hardware (**30**) from the front bottom of the first boom section.
40. Adjust sling(s) around the second boom section to help balance the second, third and fourth boom sections.
41. Remove the remainder of the second, third and fourth boom sections from the first boom section and set on suitable supports.

3.5.2 Third & Fourth Boom Section Removal



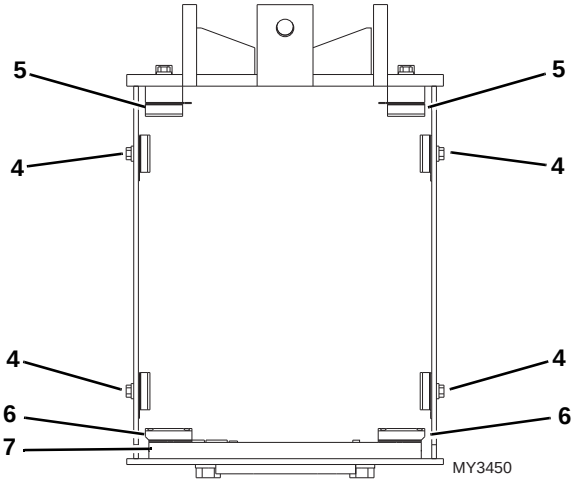
Note: *Tag each wear pad, spacer, shim and hardware from each location. Note the location of any grease fitting (if equipped) on each wear pad.*

1. Remove the top rear wear pads, spacers, shims and hardware (**1**) from the rear of the third boom section.
2. Remove the left (or right) side rear wear pad, spacer, shims and hardware (**2**) from the rear of the third boom section.
3. Verify all disconnected hoses, tubes and fittings are capped and/or plugged.



4. Pull each boom section slightly forward to relieve the tension on the retract chain (**3**).
5. Remove the snap rings and pin connecting the rear retract chain (**3**) from the chain clevis at the rear of the boom. Allow chain to hang out over the rear of the boom.

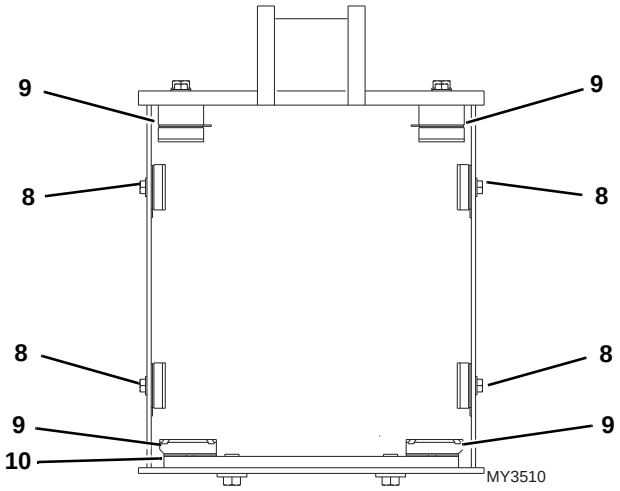
6. Place a sling around the third boom section. With a suitable lifting device, slowly pull the third and fourth boom sections approximately 25% out of the second boom section.



7. With the third and fourth boom section still connected to a suitable lifting device, remove all wear pads, spacers, shims, and hardware (**4**) from the front sides of the second boom section.
8. Remove both wear pads, spacers, shims, blocks and hardware (**5**) from the front top of the second boom section.
9. Remove both wear pads, spacers, shims and hardware (**6**) from the front bottom of the second boom section.
10. Loosen and remove the wear pad support plate (**7**) from the bottom front of the second boom section.
11. Adjust sling(s) around the third boom section to help balance the third and fourth boom sections.
12. Remove the remainder of the third and fourth boom sections from the second boom section and set on suitable supports.

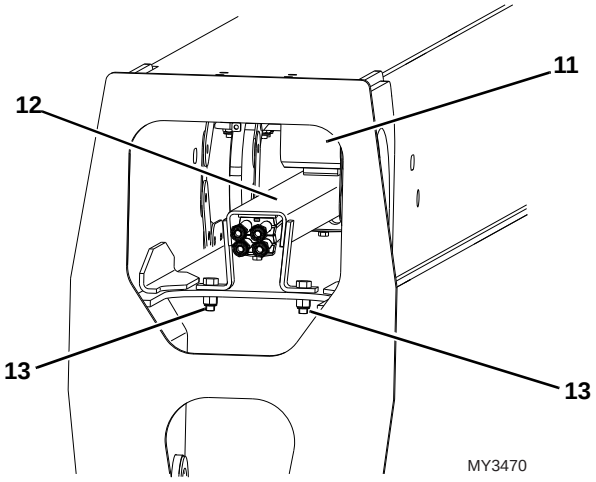
3.5.3 Fourth Boom Section Removal

1. Place a sling around the fourth boom section and slowly pull the fourth boom section approximately 25% out of the third boom section. Lower the fourth section boom head onto a suitable support.

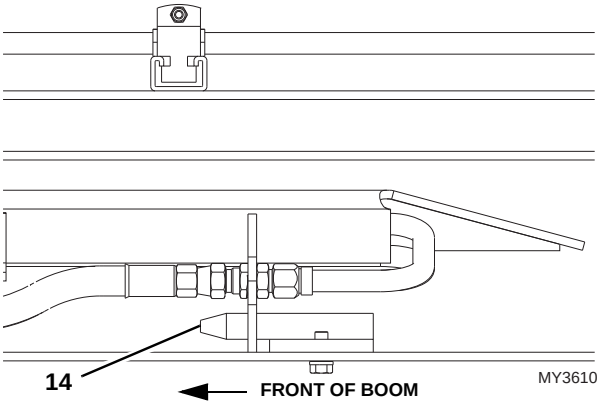


2. With the fourth boom section still connected to a suitable lifting device, remove all wear pads, spacers, shims, and hardware (**8**) from the front sides of the third boom section.
3. Remove top and bottom front wear pads, shims and blocks (**9**) from the third boom section.
4. Loosen and remove the wear pad support plate (**10**) from the bottom front of the third boom section.
5. Adjust the sling(s) around the fourth boom section for stability. Balance the fourth boom section and slowly pull the fourth boom section out of the third boom section being careful not to damage any surrounding components.
6. Lower the fourth boom section onto a suitable support.

3.5.4 Hose Carrier Removal



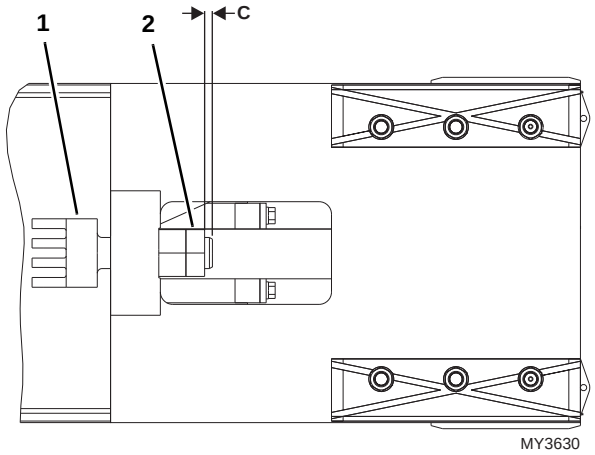
1. Remove the guide bracket (**11**) at the front of the hose carrier (**12**). Reuse the existing hardware.
2. Loosen and remove the front two mounting bolts (**13**) holding the hose carrier in place. Tag all hardware.
3. Remove the hose carrier through the front of the fourth boom section.
4. When the hose carrier is approximately 25% free of the fourth boom section, fasten the two hose carriers together (using nylon tie-wraps or nylon straps) to prevent separation.
5. Continue to remove the hose carrier, fastening the hose carriers together as they are being removed.
6. When the hose carrier is approximately 75% tied together, pull the assembly free of the boom section.
7. Lower the hose carrier onto a suitable support.



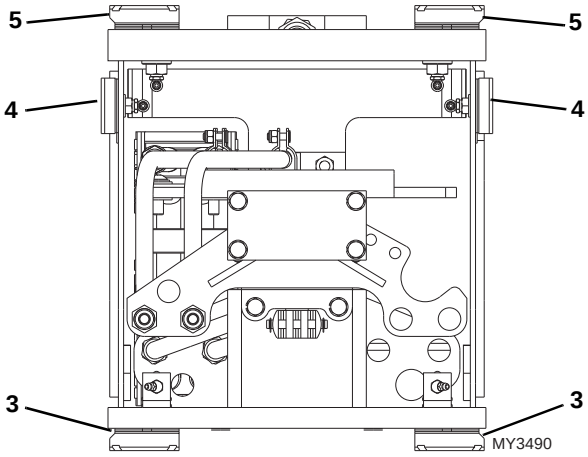
8. Remove the hose carrier guide bracket from the inside of the fourth boom section (**14**).

3.5.5 Fourth Boom Section Assembly

1. Place the fourth boom section onto suitable supports.

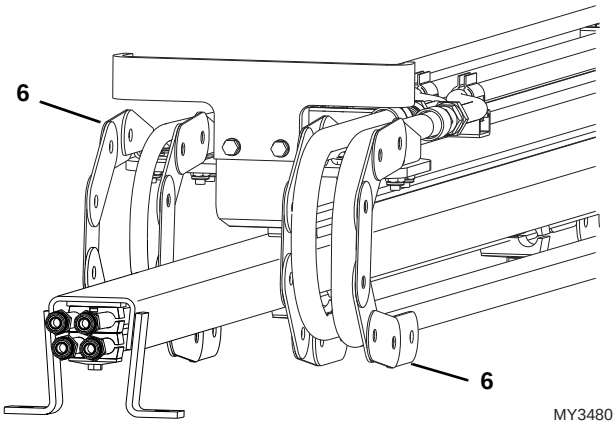


2. Install the previously removed extend chain assembly and clevis (**1**) at the top rear of the fourth boom section. Allow 0.250 in (6,35 mm)(**C**) between the end of the clevis (**1**) and the face of the lock nut (**2**). Torque lock nut to 100 lb-ft (135 Nm).

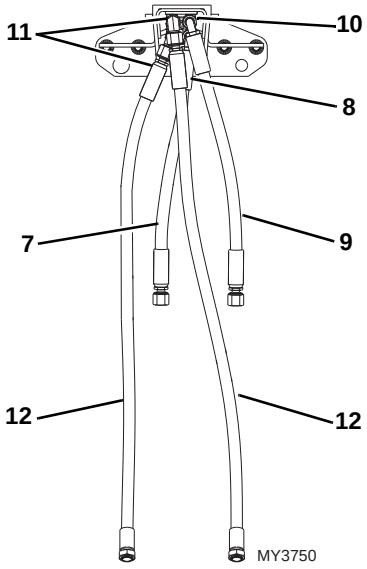


3. Install the previously removed wear pads, spacers and shims at the bottom rear of the fourth boom section (**3**). Snug mounting bolts. Shim as needed AFTER boom section is installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
4. Install the previously removed wear pads and spacers at the top rear of the fourth boom section (**4**). Snug mounting bolts. Shim as needed AFTER boom section is installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
5. Install the previously removed wear pad and spacer on each side of the fourth boom section (**5**). Snug mounting bolts. Shim as needed AFTER boom section is installed.

3.5.6 Hose Carrier Installation

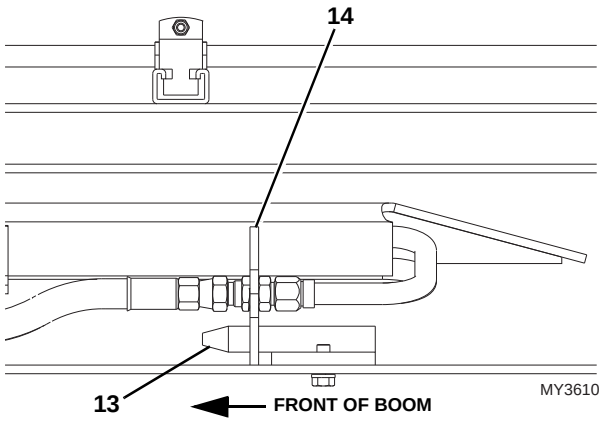


1. Inspect the hose carrier track (**6**) for any broken or missing clips. Repair or replace as needed.
2. Remove the caps from the tubes on the hose carrier.

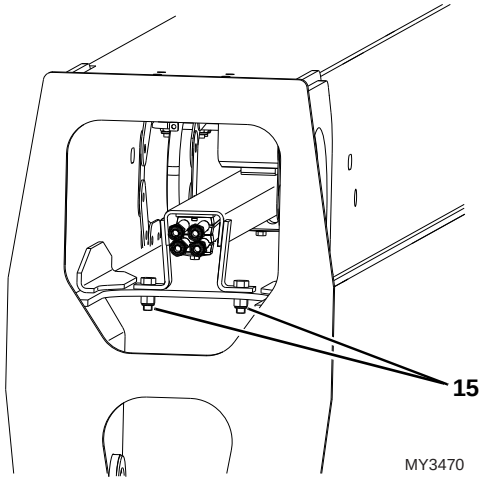


Note: *Connect the tilt cylinder hoses and the auxiliary hoses to the hose carrier bulkhead before installing the hose carrier in the fourth boom section.*

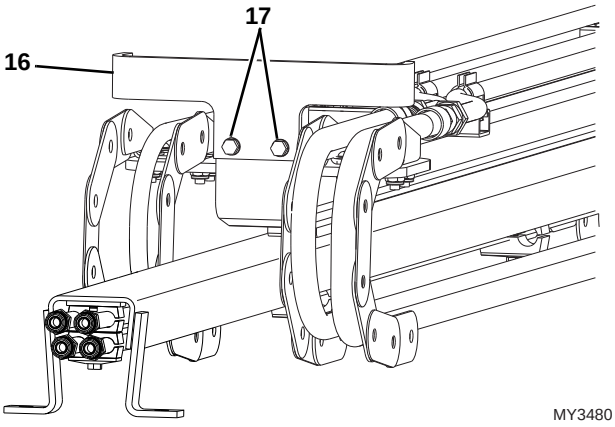
3. Install tilt cylinder hose (**7**) to the bottom left fitting on the hose carrier tube (**8**).
4. Install tilt cylinder hose (**9**) to the top left fitting on the hose carrier tube (**10**).
5. Install adaptors (**11**) to each auxiliary tube at the front right of the hose carrier.
6. Install auxiliary hoses (**12**) to each adaptor (**11**) no the auxiliary tubes at the front right of the hose carrier.
7. Orient each auxiliary hose (**12**) as shown above.
8. Torque each fitting and hose as required.



9. Install the previously removed hose carrier guide bracket (**13**). Torque as required.
10. Install the hose carrier (**14**) into the front of the fourth boom section. Remove each nylon tie or nylon strap as the hose carrier is installed.
11. Align the hose carrier (**14**) to the hose carrier guide bracket (**13**).



12. Align the hose carrier mounting bracket and install the previously removed hardware to mounting bracket at the front of the fourth boom section (**15**). Torque as required.



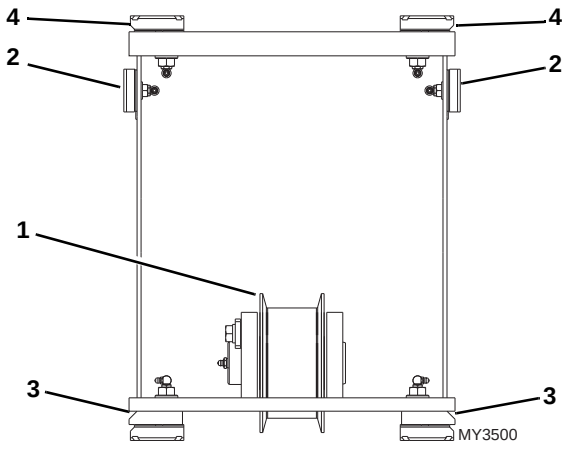
13. Install guide bracket (**16**) P/N using the previously removed hardware (**17**). Torque as required.

3.5.7 Third Boom Section Assembly

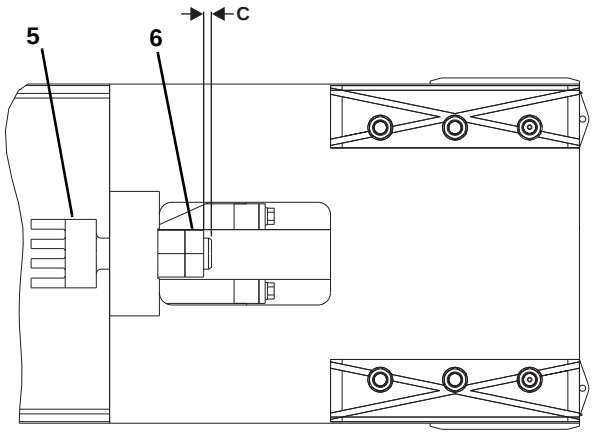
Note: *Inspect and lubricate all extend and retract chains before re-assembly. Refer to Section 3.12.1, "Boom Chain Inspection," for detailed information.*

Note: *Using a straight bar approximately 40 in (1041 mm) long will aid in the installation of the wear pads located on the inside front of each boom section.*

1. Place the third boom section onto suitable supports.



2. Install the previously removed chain roller (**1**) at the rear of the third boom section. Insert the mounting pin, retainer plate and hardware. Torque as required.
3. Install the previously removed wear pads and spacers (**2**) at each side rear of the third boom section. Snug mounting bolts. Shim as needed AFTER all boom sections are installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
4. Install the previously removed wear pads (**3**) at the bottom rear of the third boom section. Snug mounting bolts. Shim as needed AFTER all boom sections are installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
5. Install the previously removed wear pads and spacers (**4**) at top rear of the third boom section. Snug mounting bolts. Shim as needed AFTER all boom sections are installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
6. Shims may be required to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap at the top rear of the third boom section.

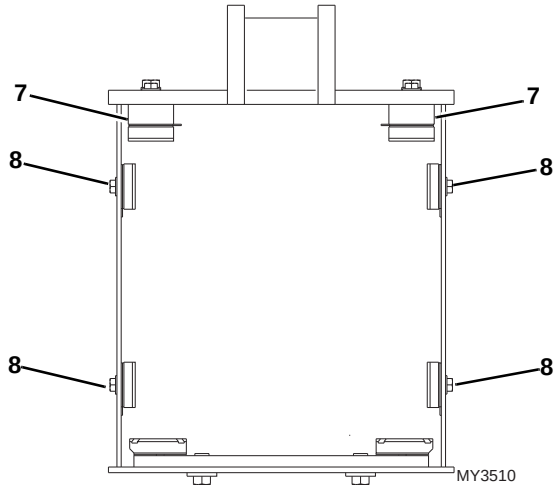


7. Install the previously removed extend chain assemblies and clevises (**5**) at the top rear of the third boom section. Allow 0.250 in (6,35 mm) between the end of the clevis (**5**) and the face of the lock nut (**6**). Torque lock nut to 100 lb-ft (135 Nm).

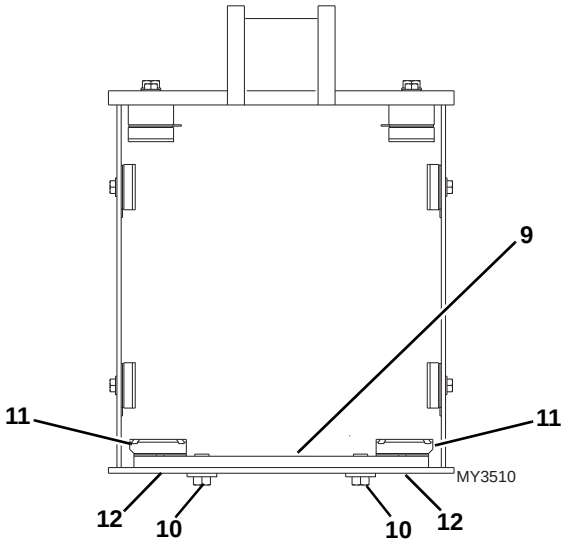
3.5.8 Fourth Boom Section Installation

Note: *Using a straight bar approximately 40 in (1041 mm) long will aid in the installation of the wear pads located on the inside front of each boom section.*

1. Clean and lubricate the bottom of the fourth boom section where the wear pads of the third boom section contact the fourth boom section.
2. Place the sling, or two slings for better stability, around the fourth boom section and slowly insert the fourth boom section into the third boom section being careful not to damage any surrounding components.



3. Install the previously removed wear pad support plates and spacers (**7**) with existing hardware at the inside top front of the third boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
4. Install the previously removed wear pads, spacers and shims on each side at the front of the third boom section (**8**). Snug mounting bolts. Shim as needed AFTER boom section is installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.

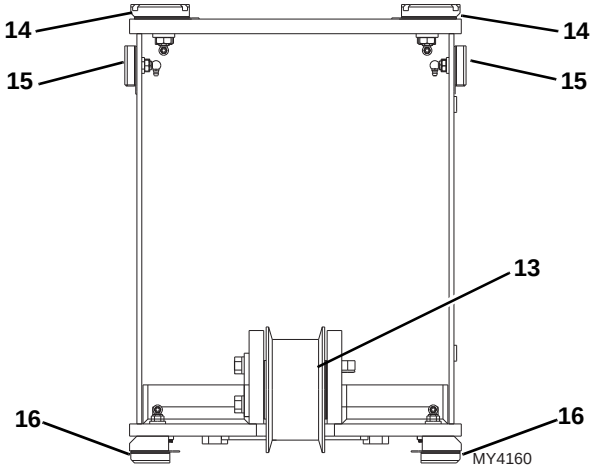


5. Install the previously removed wear pad support (**9**) at the front inside of the third boom section. Use the previously removed hardened washers and bolts (**10**). Torque as required.
6. Install the previously removed wear pads, spacers and shims at the bottom front of the third boom section (**11**). Snug mounting bolts.

Note: *Longer bolts (**12**) may be required to fully engage the threaded inserts in the wear pads without allowing bolts to protrude past the chamfer on the wear pads. Refer to page 6, Wear Pad Installation and Lubrication for detailed information.*

3.5.9 Second Boom Section Assembly

1. Place the second boom section onto suitable supports.



2. Install the previously removed chain roller (**13**) at the rear of the second boom section. Insert the mounting pin, retainer plate and hardware. Torque as required.
3. Install the previously removed wear pads and spacers (**14**) at the top rear of the second boom section. Snug mounting bolts. Shim as needed AFTER all boom sections are installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
4. Install the previously removed wear pads and spacers (**15**) at each side rear of the second boom section. Snug mounting bolts. Shim as needed AFTER all boom sections are installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
5. Install the previously removed wear pads and spacers (**16**) at the bottom rear of the second boom section. Snug mounting bolts. Shim as needed AFTER all boom sections are installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
6. Shims may be required to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap at the top rear of the second boom section

3.5.10 Third & Fourth Boom Section Installation

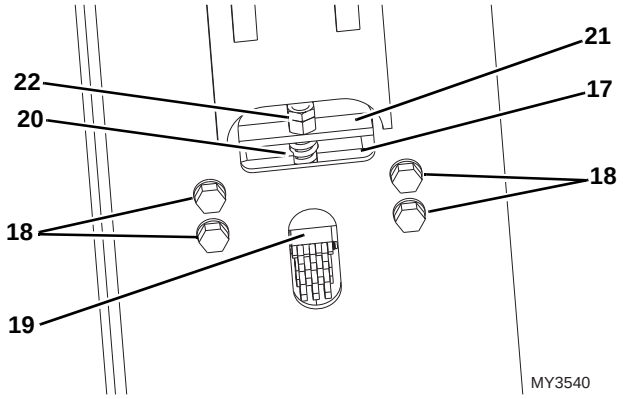
Note: *Refer to Section 2.2, "Torque Charts," for standard bolt torque information.*

Note: *Refer to Section 2.2.3, "Hydraulic Hose Torque Chart," for standard hose torque information.*

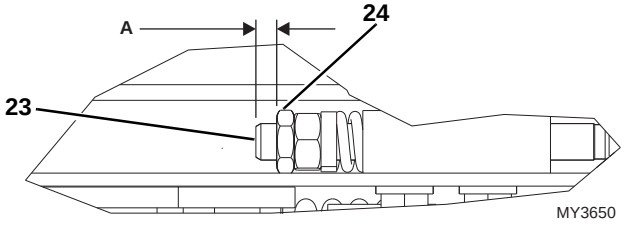
Note: *Apply Loctite® 242 to all boom assembly bolts.*

Note: *Using a straight bar approximately 40 in (1041 mm) long will aid in the installation of the wear pads located on the inside front of each boom section.*

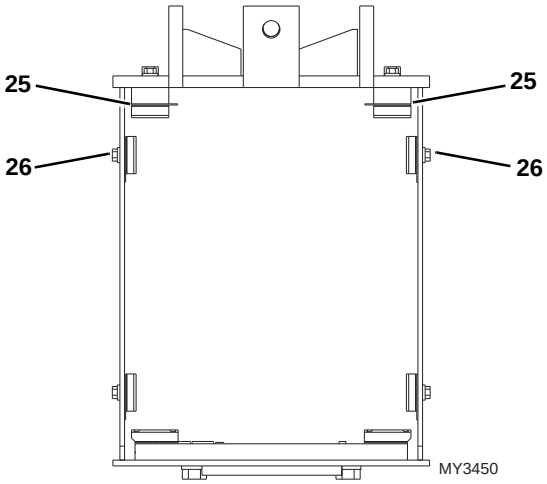
1. Place the sling or using two slings for better stability, around the third boom section and slowly insert the third and fourth boom sections into the second boom section being careful not to damage any surrounding components.



2. Install adjusting block (**17**) using existing hardware (**18**). Torque as required.
3. Install chain & clevis (**19**), spring (**20**), spring stop (**21**), adjusting nut and lock nut (**22**).



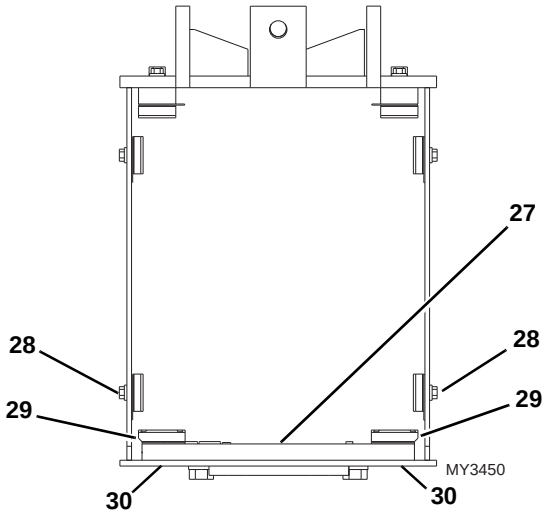
4. Allow 0.50 in (1,27 mm)(**A**) between the end of the clevis (**23**) and the face of the lock nut (**24**). Torque lock nut to 100 lb-ft (135 Nm).
5. Properly connect the battery.
6. Retract the second boom section pulling both retract chains at the same time.



7. Install the previously removed wear pad support plates and spacers (**25**) with existing hardware at the inside top front of the second boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.

Note: *Longer bolts may be required to fully engage the threaded inserts in the wear pads without allowing bolts to protrude past the chamfer on the wear pads. Refer to Section 3.11.2, "Wear Pad Installation and Lubrication."*

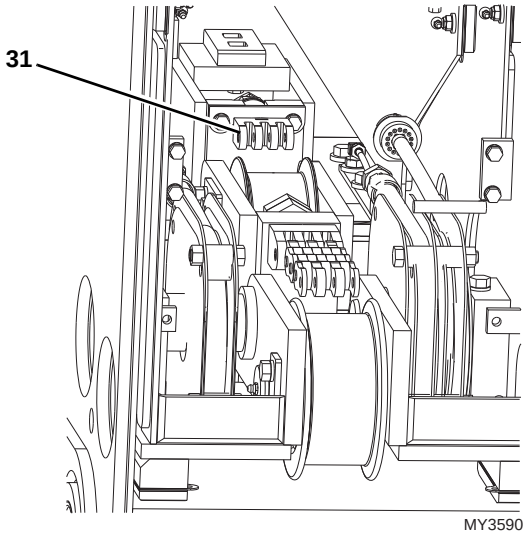
8. Install the previously removed wear pads, spacers and shims on each side at the front of the second boom section (**26**). Snug mounting bolts. Shim as needed AFTER boom section is installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.



9. Install the wear pad support plate (**27**) with existing hardware at the inside front of the second boom section.
10. Install the previously removed wear pads, spacers and shims at the bottom front of the second boom section (**28** & **29**). Snug mounting bolts.

Note: *Longer bolts (**30**) may be required to fully engage the threaded inserts in the wear pads without allowing bolts to protrude past the chamfer on the wear pads. Refer to Section 3.11.2, "Wear Pad Installation and Lubrication."*

11. Manually retract the boom sections as required to connect the retract chains.

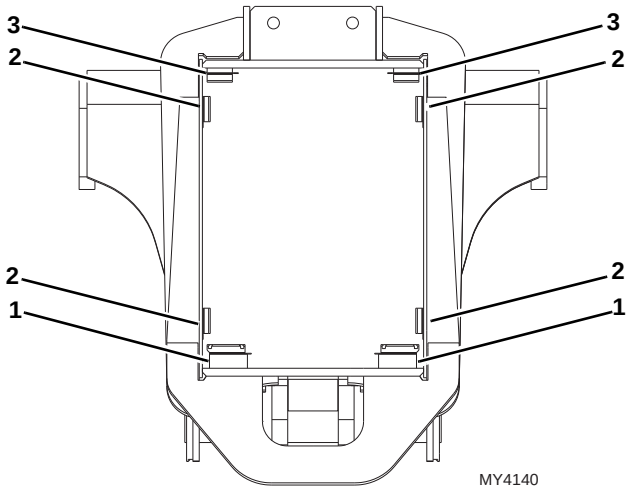


12. Install the bracket and clevis assembly (**31**) at the rear of the fourth boom section. Torque mounting bolts.

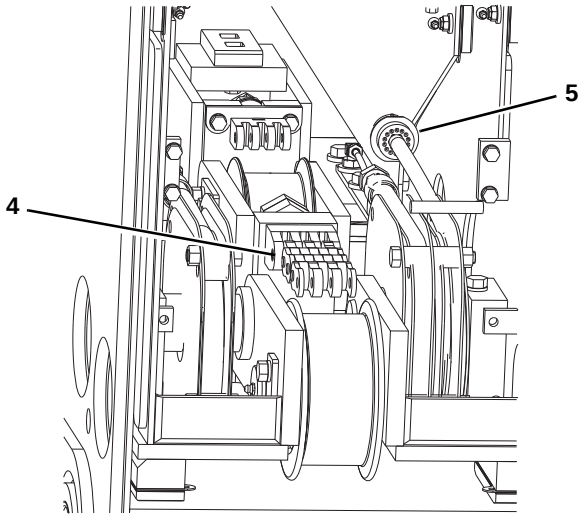
3.5.11 Second, Third and Fourth Boom Section Installation

Note: *Using a straight bar approximately 40 in (1041 mm) long will aid in the installation of the wear pads located on the inside front of each boom section.*

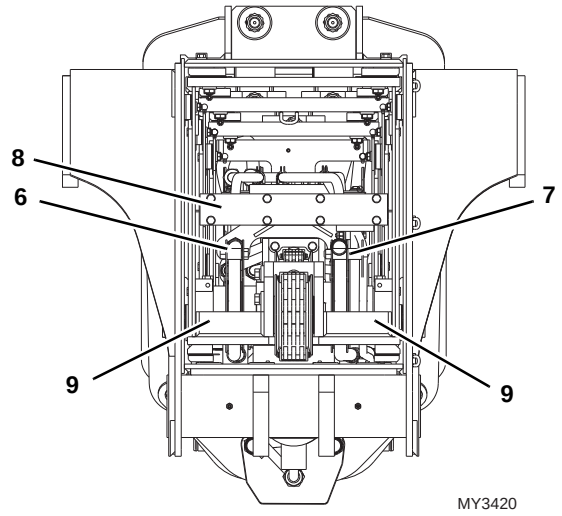
1. Place the sling or using two slings for better stability, around the second boom section and slowly insert the second, third and fourth boom sections into the first boom section being careful not to damage any surrounding components and allowing sufficient room to install the wear pads at the front of the first boom section.



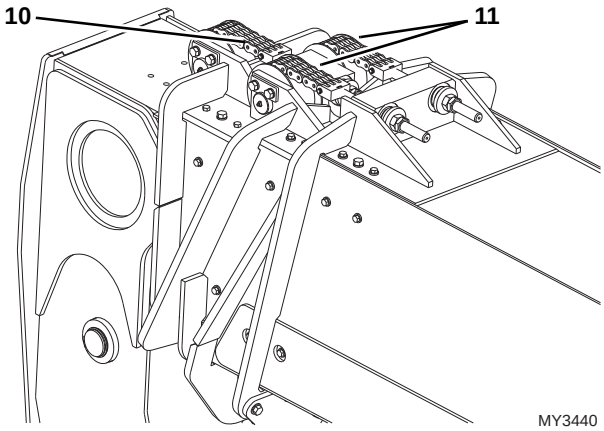
2. Install the previously removed wear pads, spacers and shims at the bottom front of the first boom section (**1**). Snug mounting bolts. Shim as needed AFTER boom section is installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
3. Install the previously removed wear pads, spacers and shims on each side at the front of the first boom section (**2**). Snug mounting bolts. Shim as needed AFTER boom section is installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
4. Install the previously removed wear pads, spacers and shims at the top front of the first boom section (**3**). Snug mounting bolts. Shim as needed AFTER boom section is installed to maintain a 0.070 - 0.130 in (1,78 - 3,30 mm) gap between the boom sections.
5. Re-adjust the sling(s) and push the second, third and fourth boom assembly the remainder of the way into the first boom section.



6. Connect the rear retract chain (**4**) to the chain clevis with the previously removed pin at the rear of the third boom section. Secure the pin with the previously removed snap rings.
7. Pull hose carrier from the rear as far as possible to access the hydraulic and if equipped, the electrical connections.
8. If equipped, connect the electrical cable (**5**) to the fitting on the hose carrier.



9. Remove any caps and plugs from the tilt and auxiliary hoses at the rear of the boom assembly. Connect and tighten the tilt (**6**) and auxiliary hoses (**7**) to their proper fitting locations on the hose carrier. Torque as required.
10. Install the hose carrier bracket (**8**) at the rear of the third boom section and the hose carrier. Torque mounting bolts as required.
11. Install both hose sheave covers (**9**).Torque mounting bolts as required.



12. Connect the fourth boom section extend chain (**10**) to the clevis at the top front of the third boom section and adjust to the previously measured setting. Do Not tighten the lock nut at this time.
13. Connect the third boom section extend chains (**11**) to the clevises at the top front of the second boom section and adjust to the previously measured setting. Do Not tighten the lock nut at this time.
14. Grease all wear pad at the rear of the boom using the zerk fittings.
15. Refer to Section 3.7, “Boom Section Separation Adjustment,” for proper boom section adjustments.

3.6 EXTEND/RETRACT CHAIN REMOVAL/INSTALLATION

3.6.1 Retract Chain Removal

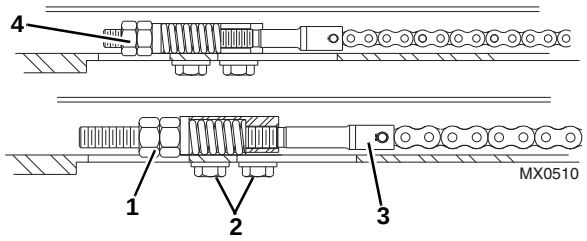
The following section explains the removal of the retract chains without removing the boom assemblies.

Note: *The retract chain on the bottom of the boom must be removed to gain access to the inner retract chain.*

To remove the retract chain from the third to first boom sections:

1. Park the machine on level ground. Place the transmission control lever in (N) NEUTRAL, engage the parking brake switch, level the boom and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Properly disconnect the battery.

4. Attach a suitable sling to the extend/retract cylinder. Remove the extend/retract cylinder support.
5. Remove the rod end pin and lower the cylinder onto the frame rails. Lowering the extend/retract cylinder will allow access to the chains.



6. Remove tension from the chain by backing off the jam nut and adjusting nut (**1**).
7. Remove the four bolts (**2**) from the chain adjustment block.
8. Remove the chain from the clevis (**3**) at the block.
9. Install a nylon tie wrap through the holes of the removed chain, making a loop with a tie wrap and tie a rope to the loop.
10. At the rear of the boom, pull the chain to the rear to allow slack for removal.
11. Remove the chain from the clevis and drop it free from the boom.
12. Holding a rope at the front adjustment block, carefully pull the chain out through the back of the boom.
13. Untie the rope and leave it in place for reinstallation of the chain.

To remove the retract chain from the fourth to second boom sections:

1. Remove the jam nut (**4**) from the chain clevis installed in the chain adjustment block.
2. Back off the adjusting nut fully on the chain clevis. Do not remove the nut from the clevis.
3. Remove the chain from the clevis, install a nylon tie-wrap through the holes in the chain, making a loop with the tie-wrap and tie a rope to the loop.
4. Move to the back of the boom and pull the chain to the rear to allow slack for removal.
5. Remove the chain from the clevis and drop it free from the boom.
6. Holding the rope at the front, carefully pull the chain out through the back of the boom until it's free.
7. Untie the rope and leave it in place for reinstallation of the chain.

3.6.2 Retract Chain Installation

Inspect and lubricate chains thoroughly before installation. Articulate the chains to make sure all working surfaces are thoroughly lubricated.

Note: *If the inner retract chain was removed, it must be installed first.*

1. Fasten a rope to the end of the 3/4 in. chain in order to pull it back into the boom.
2. Attach the chain to the chain clevis at the rear of the boom.
3. Carefully pull the chain into the boom until it can be fastened to the chain clevis.
4. Remove the rope.
5. Fasten the chain into the clevis by installing the pin and retaining ring.
6. Torque the jam nuts to 100 lb-ft (135 Nm).

To install the outer retract chain:

1. Fasten a rope to the end of the chain in order to pull it back into the boom.
2. Attach the chain to the chain clevis at the rear of the boom.
3. Carefully pull the chain into the boom until it can be fastened to the chain clevis.
4. Remove the rope.
5. Fastened the chain into the clevis by installing the pin and cotter pin.
6. Install the chain adjustment block and mounting bolts. Torque the chain adjustment block mounting bolts to 360-390 lb-ft (475-530 Nm).
7. Install the extend/retract cylinder and cylinder support.
8. Adjust the retract chains as needed. Refer to Section 3.7, "Boom Section Separation Adjustment."
9. Properly connect the battery.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

3.6.3 Extend Chain Removal

The following section explains the removal of the extend chains without removing the boom assemblies.

1. Park the machine on level ground. Place the transmission control lever in (N) NEUTRAL, engage the parking brake switch, level the boom, extend the boom far enough to access the chain anchor and the clevis through the top rear access hole, shut the engine OFF.

2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Properly disconnect the battery.
4. Secure the boom sections together to prevent uncontrolled boom run out when the extend chains are removed.
5. On the chain being removed, loosen and remove the jam nut from the rear chain clevis and back off the adjusting nut on the chain clevis to the end of the threads. Do not completely remove the nut.
6. Remove the chain clevis pin and retaining ring to free the chain.
7. Install the nylon tie wrap through the holes in the chain, making a loop with the tie wrap and tie a rope to the loop.
8. Pull the slack to the chain clevis at the front of the boom.
9. Remove the clevis pin and the retaining ring from the chain and chain clevis.
10. Install a nylon tie wrap through the chain holes, forming a loop and tie a rope to the loop.
11. Carefully pull the chain out of the boom.
12. Untie the rope and leave it in place for reinstallation of the chain.

3.6.4 Extend Chain Installation

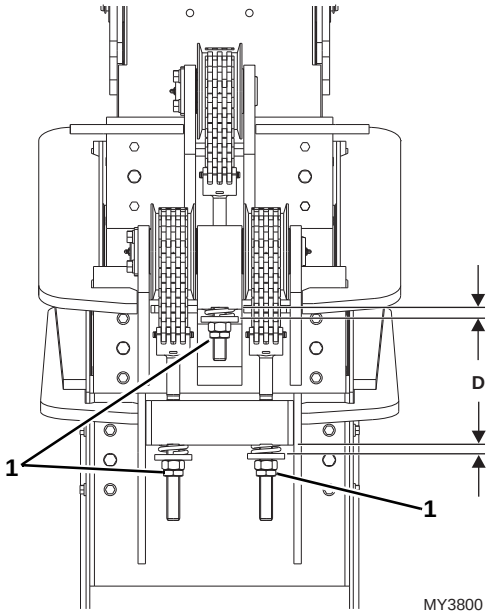
The following section explains the installation of the retract chains without removing the boom assemblies.

Inspect and lubricate chains thoroughly before installation.

1. Fasten the previously used rope to the end of the extend chain.
2. Carefully pull the chain into the boom to the chain clevis anchor.
3. Fasten the chain to clevis with a pin and cotter pin.
4. At the other end of the chain, connect the chain to the clevis fastening the chain to the clevis with a pin and retaining ring.
5. Install the chain clevis fastening and adjusting hardware on both ends.
6. Remove any clamping devises being used to keep the boom sections from moving.
7. Properly connect the battery.
8. Adjust the extend chains as needed. Refer to Section 3.7, “Boom Section Separation Adjustment.”
9. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

3.7 BOOM SECTION SEPARATION ADJUSTMENT

1. Start the machine and verify the boom is in a horizontal (level) position.
2. Extend the boom 4-5 ft (1,2-1,5 m), then fully retract the boom.
3. Shut machine OFF.



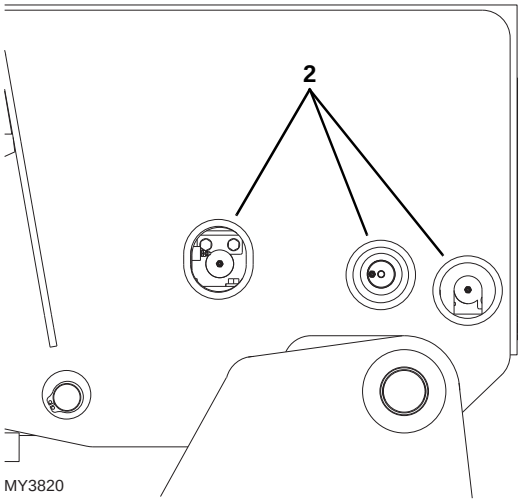
4. Measure the gap (**D**) between the flat washer at the extend chain anchor on the top front of the first boom section and the second boom section. If the gap is greater that 0.375 in (9.52 mm), the boom chains will need to be adjusted.

Adjust the extend chain as follows:

1. Loosen the lock nut (**1**) on each of the extend chains.
2. Tighten the adjusting nuts on the first boom section until the gap (**D**) between the flat washers and boom is 0.375 in (9,52 mm) maximum. The gap must be equal on both chains. Torque the lock nut to 100 lb-ft (135 Nm).

Note: *Verify the exposed threads on both extend chain clevises are kept equal.*

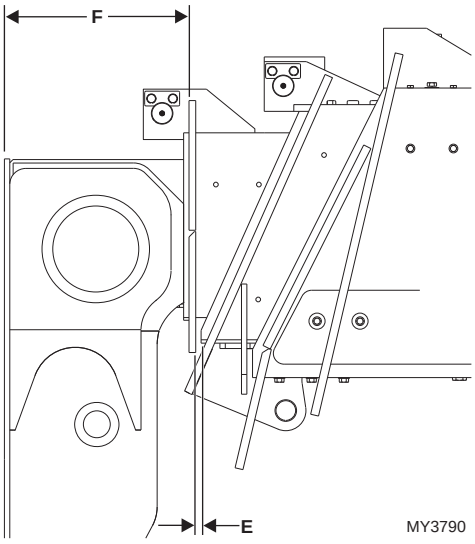
3. Tighten the adjusting nut on the second boom section until the gap (**D**) between the washer and boom is 0.375 in (9,52 mm) maximum. Torque the lock nut to 100 lb-ft (135 Nm).



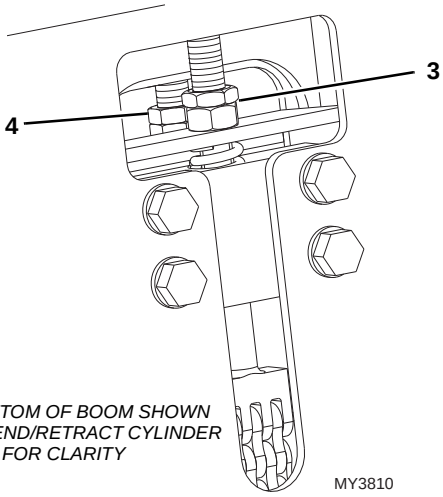
4. After adjusting, check to see that the boom sections and access holes (**2**) are aligned. If they are not, the retract chain will need to be adjusted as well.

Adjust the retract chain as follows:

1. Fully retract the boom.



2. Measure the distance between the second boom section and the third boom section (**E**). The dimension should be 0.50-0.75 in (12,7-19,5 mm).



Note: *BOTTOM OF BOOM SHOWN WITH EXTEND/RETRACT CYLINDER REMOVED FOR CLARITY*

3. Loosen the second to third boom section retract chain lock nut and adjusting nut (**3**) as far as possible.
4. Loosen the third to fourth boom section retract chain lock nut and adjusting nut (**4**) as far as possible.
5. Tighten the retract chain adjusting nut (**3**) until the proper distance (**E**) is obtained and proper access hole alignment (**2**) is obtained.
6. Torque the lock nut to 100 lb-ft (135 Nm).
7. Recheck the extend chain adjustments and readjust if necessary.
8. Measure the distance between the third boom section and fourth boom section (**F**). The dimension should be:
   G10-55A - 17.5-17.75 in (444,5-451,3 mm)
   G12-55A - 18.5-18.75 in (469,9-476,7 mm)
9. Tighten the retract chain adjusting nut (**4**) until the proper distance (**F**) is obtained and proper access hole alignment (**2**) is obtained.
10. Torque the lock nuts to 100 lb-ft (135 Nm).
11. Re-adjust the extend chains as needed.

3.8 HOSE CARRIER ASSEMBLY REMOVAL/INSTALLATION

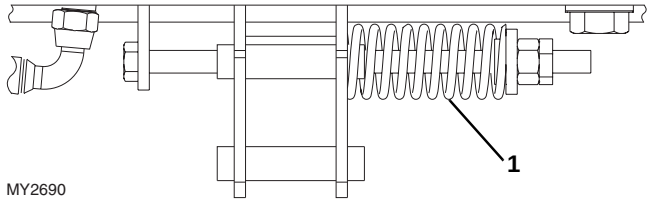
The hose carrier assembly locates primarily in the fourth boom section. It is fastened at the bottom front of the fourth boom section and at the rear of the third boom section.

3.8.1 Hose Carrier Assembly Removal

1. Remove any attachment from the quick switch assembly. Refer to the appropriate operation and safety manual.

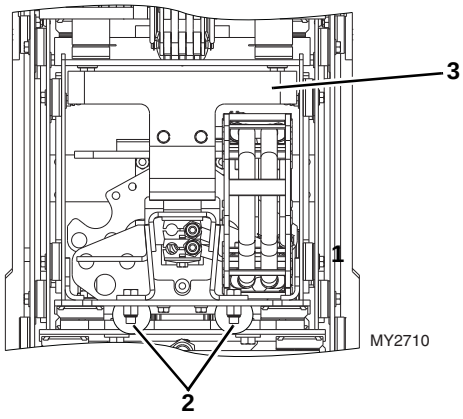
Note: *Allow adequate room in front of the machine when removing and installing the hose carrier assembly.*

2. Park the machine on a hard, level surface, level the machine, fully retract the boom, level the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
3. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
4. Open the engine cover. Allow the system fluids to cool.
5. Properly disconnect the battery.

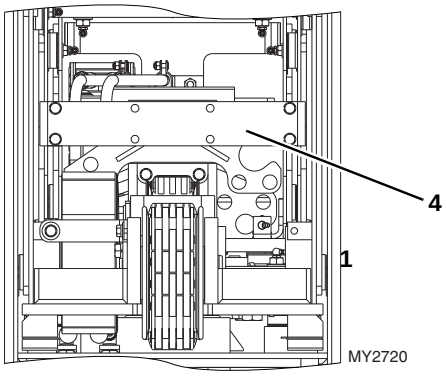


6. Loosen and remove both compression springs (**1**) from the hose take-up weldment at the bottom of the first boom section.
7. Label and disconnect the tilt and auxiliary hydraulic hoses attached to the hose carrier at the rear of the boom and at the front of the boom head. Plug and cap the hose ends to prevent dirt and debris from entering the hydraulic system.
8. If equipped, label and disconnect any electrical connections at the front and rear of the boom assembly.

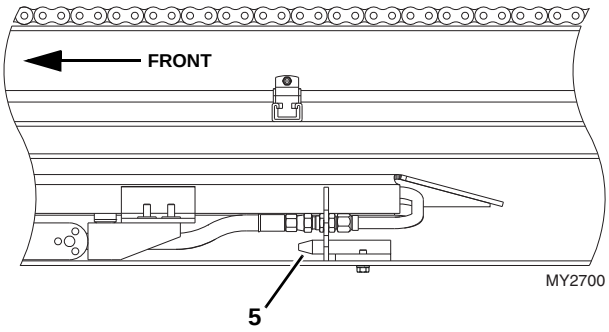
Note: *Tag or identify each hose to the corresponding fitting it was removed from.*



9. Loosen and remove both cap screws and locknuts (**2**) from the hose carrier bracket at the front of the fourth boom section.
10. Loosen and remove the guide bracket (**3**) from the front of the fourth boom section.



11. Loosen and remove the hose carrier bracket (**4**) at the rear of the third boom section.



12. Install a sling around the hose carrier at the front of the boom. With a suitable lifting device, slowly pull the hose carrier loose from the bottom bracket (**5**) located approximately halfway in the fourth boom section.

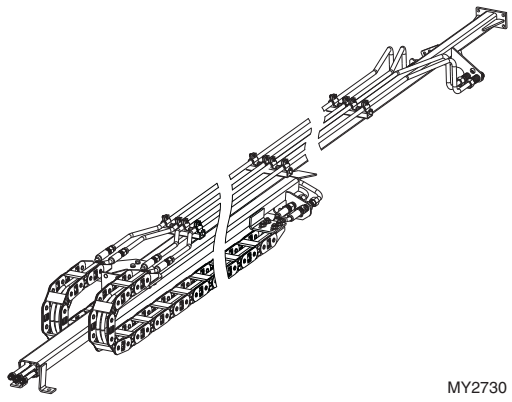
13. When the hose carrier is pulled approximately 25% out of the boom, fasten the two hydraulic carriers together using plastic tie wraps or nylon straps to keep them from separating.

Note: *Do Not wrap the hose carrier since it will not prevent the two hydraulic carriers from moving apart sideways.*

14. Continue withdrawing the hose carrier, fastening the two hydraulic carriers together.
15. With the two hose assemblies tied together, remove the hose carrier and set on the ground or proper supports.

3.8.2 Assembling the Hose Carrier Assembly

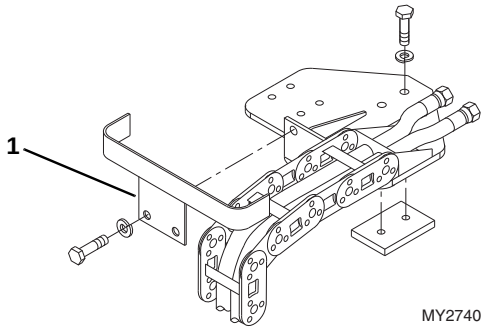
The following procedure is described with the assumption that all components have been removed and assembly proceeding from the beginning.


MY2730

1. Place both sections on a suitable stand or support.
2. Install the wear pad to the bottom of the upper hydraulic carrier.
3. Install the bulkhead fittings to the each hydraulic carrier.
4. Install the tube assemblies to the bulkhead fittings on each hydraulic carrier.
5. Install the cushion clamps to the tube assemblies and secure to each hydraulic carrier.
6. Install the hose carrier to each hydraulic carrier and install each tilt hose and auxiliary hose to the proper fitting or tube connection.
7. Tie wrap the hydraulic hoses together where they extend from each end of the hose carrier.
8. Fasten the two hydraulic carriers together using plastic tie wraps or nylon straps for stability.

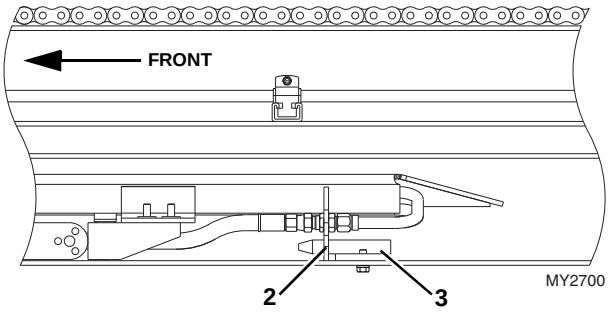
3.8.3 Hose Carrier-Assembly Installation

1. Clean and lubricate the side surfaces where the hose carrier rides.
2. Fully collapse the hose carriers and secure together using plastic tie wraps or nylon straps to keep them from separating.
3. Install a sling around the balance point of the hose carrier. With a suitable lifting device, slowly insert the hose carrier into the front of the fourth boom section.
4. Remove the first plastic tie wrap or nylon strap as the hose carrier is being inserted into the front of the fourth boom section.
5. Continue inserting the hose carrier and removing the plastic tie wraps or nylon straps until the hose carrier is fully inserted into the boom.



MY2740

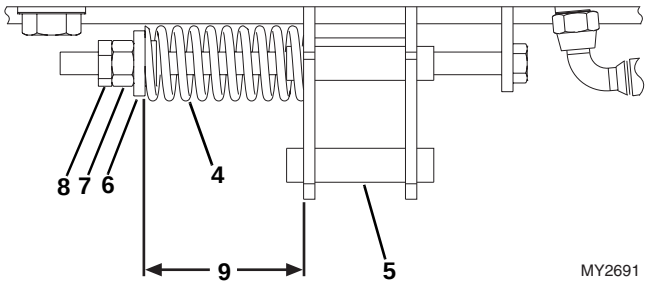
6. Install the guide bracket (**1**) on the front of the hose carrier.



MY2700

7. Verify that the bottom bracket (**2**) on the hose carrier is in place on the bottom plate (**3**) of the fourth boom section.
8. Install the cap screws, washers and nuts to the hose carrier bracket at the rear of the third boom section.
9. Install both cap screws and locknuts to the hose carrier bracket at the front of the fourth boom section.
10. Uncap and reconnect the previously labeled tilt and auxiliary hydraulic hoses to the proper fittings at the rear of the hose carrier.

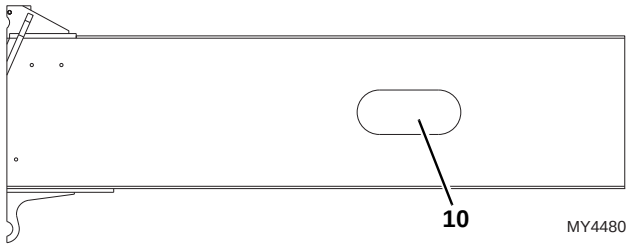
11. Uncap and reconnect the previously labeled tilt and auxiliary hydraulic hoses to the proper fittings at the front of the fourth boom section.
12. If equipped, reconnect any electrical connections at the front and rear of the boom assembly.



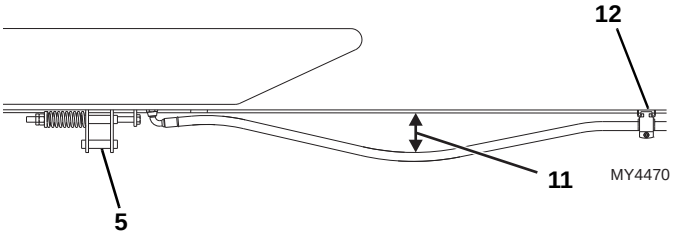
13. Install the hose take-up compression spring (**4**) on each hose take-up bracket (**5**) at the bottom of the first boom section. Install the washer (**6**), adjusting nut (**7**) and jam nut (**8**). Tighten the adjusting nut (**7**) to compress the hose take-up compression spring to measure 3 in (76,20 mm)(**9**). Refer to Section 3.8.4, “Boom Hose Adjustment,” if required.
14. Torque the jam nut (**8**) against the adjusting nut (**7**) to 100 ft-lbs (135,5 Nm).
15. Properly connect the battery.
16. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

3.8.4 Boom Hose Adjustment

1. Park the machine on a hard, level surface, level the machine, fully extend the boom, lower the boom head to the ground, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Verify any trapped hydraulic pressure in the auxiliary circuit and the tilt circuit is relieved.
4. Open the engine cover. Allow the system fluids to cool.



5. Verify the auxiliary hoses and/or tilt hoses are NOT touching the bottom of the second boom section by viewing the auxiliary hoses and/or tilt hoses through the access hole (**10**) in each side of the second boom section.



6. Verify that 4 in (101,6 mm) of slack (**11**) is present between the hose take-up bracket (**5**) and the first hose clamp (**12**).
7. Verify the hose take-up bracket (**5**) is not bent and is at an 85° angle to the hose.

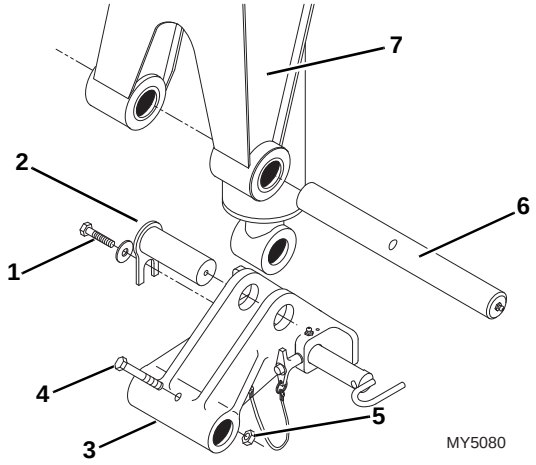
Note: *Replace both auxiliary hoses and/or tilt hoses if the hoses are touching the bottom of the second boom section AND 4 in (101,6 mm) of slack is present between the hose take-up bracket and the first hose clamp.*

8. Refer to Section 3.8.3, “Hose Carrier-Assembly Installation,” step 13 and 14 for hose take-up bracket adjustment.
9. Measure the slack (**11**) at the lowest point between the hose take-up bracket (**5**) and the first hose clamp (**12**). The 4 in (101,6 mm) measurement is from the bottom of the first boom section to the top of the hose.
10. If necessary, loosen the hose clamp (**12**), pull the auxiliary hoses and/or the tilt hoses, tighten the hose clamp for additional clearance.
11. Replace the auxiliary hoses and/or the tilt hoses if the proper slack, 4 in (101,6 mm)(**11**) cannot be achieved.
12. Start the machine, raise the boom to level, cycle the extend/retract cylinder, fully extend the boom.
13. Cycle the auxiliary circuit and/or the tilt circuit, verifying the auxiliary hoses and the tilt hoses are NOT touching the bottom of the second boom section and the proper slack, 4 in (101,6 mm) is maintained.
14. Retract the boom and shut engine OFF.
15. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

3.9 QUICK SWITCH ASSEMBLY

3.9.1 Quick Switch Removal

Before S/N 0160037689



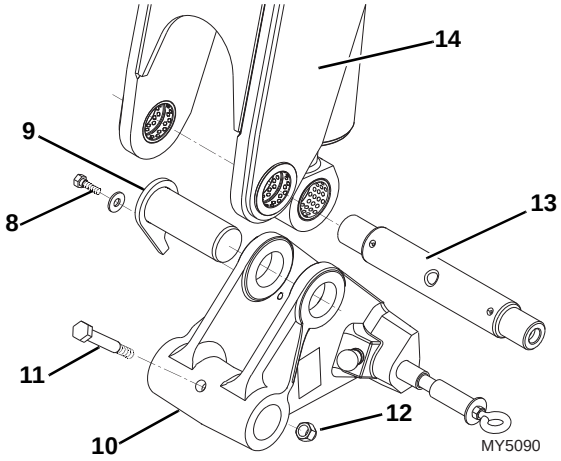
1. Remove the lock bolt (**1**) holding the tilt cylinder rod end pin (**2**) to the quick switch assembly (**3**). Remove the Tilt Cylinder pin.
2. Support the quick switch assembly (**3**).Remove the capscrew (**4**) and locknut (**5**) securing the head pin (**6**) to the boom head (**7**).
3. Inspect the above pins for nicks or surface corrosion. Use fine emery cloth to fix minor nicks or corrosion. If damaged or if it cannot be repaired the pin must be replaced.

3.9.2 Quick Switch Installation

1. Assemble the quick switch assembly (**3**) to the boom head (**7**). Line up the quick switch between the mounts on the boom head. The quick switch should be centered in the boom head.
2. Coat the quick switch head pin (**6**) with an anti-seize compound. Insert the quick switch head pin through the quick switch and boom head. Secure with the previous capscrew (**4**) and locknut (**5**).
3. Align the quick switch with the tilt cylinder rod end and insert the tilt cylinder pin (**2**). Align the tilt cylinder pin and screw in the locking bolt (**1**). Torque as required.

3.9.3 Quick Switch Removal

S/N 0160037689 & After



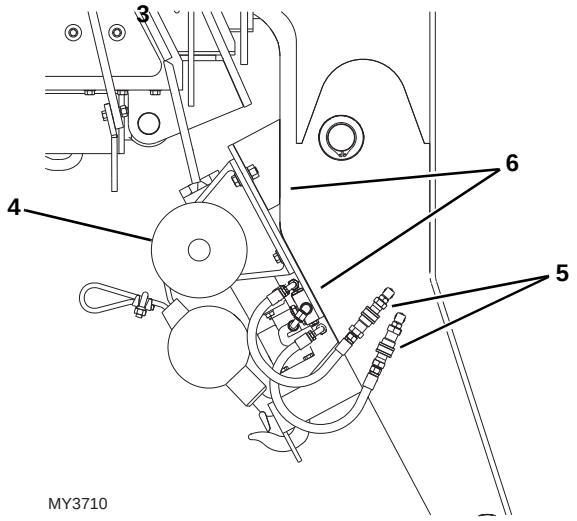
1. Remove the lock bolt (**8**) holding the tilt cylinder rod end pin (**9**) to the quick switch assembly (**10**). Remove the Tilt Cylinder pin.
2. Support the quick switch assembly (**10**).Remove the capscrew (**11**) and locknut (**12**) securing the head pin (**13**) to the boom head (**14**).
3. Inspect the above pins for nicks or surface corrosion. Use fine emery cloth to fix minor nicks or corrosion. If damaged or if it cannot be repaired the pin must be replaced.

3.9.4 Quick Switch Installation

1. Assemble the quick switch assembly (**10**) to the boom head (**14**). Line up the quick switch between the mounts on the boom head. The quick switch should be centered in the boom head.
2. Coat the quick switch head pin (**13**) with an anti-seize compound. Insert the quick switch head pin through the quick switch and boom head. Secure with the previous capscrew (**11**) and locknut (**12**).
3. Align the quick switch with the tilt cylinder rod end and insert the tilt cylinder pin (**9**). Align the tilt cylinder pin and screw in the locking bolt (**8**). Torque as required.

3.10 BOOM HEAD - MOUNTED WINCH

3.10.1 Boom Head-Mounted Winch Removal



1. Using a suitable lifting device, secure the winch assembly (**4**) with a nylon strap.
2. Disconnect the hydraulic hoses (**5**).
3. Loosen and remove the mounting bolts, washers and nuts (**6**)(not shown).
4. Lower the winch assembly (**4**) onto a suitable skid or table.

3.10.2 Boom Head-Mounted Winch Installation

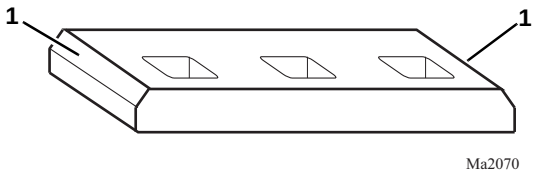
1. Using a suitable lifting device, secure the winch assembly (**4**) with a nylon strap.
2. Raise the winch assembly (**4**) into position behind the boom head.
3. Apply Loctite® 242 to the previously removed mounting bolts.
4. Install the mounting bolts, washers and nuts (**6**)(not shown). Torque to 200 lb-ft (271 Nm).
5. Connect the hydraulic hoses (**5**).

3.11 BOOM WEAR PADS

The wear pads on this machine are flat rectangular wear pads with metal inserts.

A total of 42 wear pads are installed on the boom sections of the G10-55A and the G12-55A machines.

3.11.1 Wear Pad Inspection



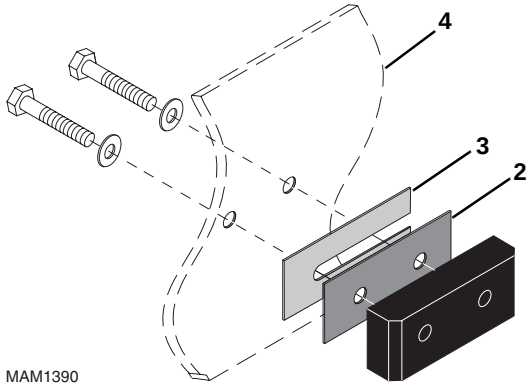
Inspect all wear pads for wear. If the angle indicators (**1**) on the ends of the wear pads are visible, the wear pads can be reused. If the pads show uneven wear (front to back), they should be replaced. Replace pads as a set if worn or damaged.

3.11.2 Wear Pad Installation and Lubrication

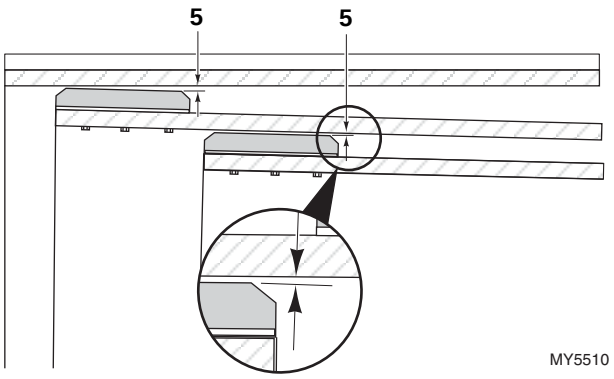
Note: *Inspect all wear pads. Replace as necessary.*

The following wear pad procedure must be followed to insure the proper wear pad installation:

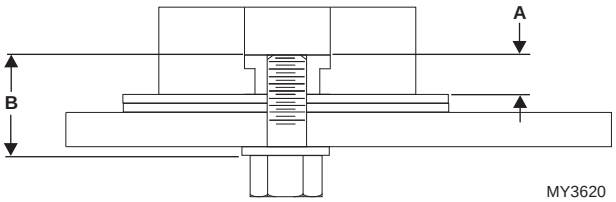
- The wear pad inserts and mounting bolts MUST be clean from any grease, oil or other contaminates before applying Loctite® 242 and installing mounting bolts.
- Apply Loctite® 242 to all wear pad mounting bolts.



- A spacer (**2**) with holes must be used before any shim (**3**) is used.
- A shim (**3**) must be inserted between the spacer (**2**) and wear pad support plate, block or boom section (**4**).
- The number of shims can vary at each shim point.
- The bottom wear pads must be shimmed equally on each side.



- Maintain a total boom section clearance (**5**) of 0.070 - 0.130 in (1,78 - 3,30 mm) both the horizontal and vertical directions.



- The length of the wear pad bolt depends on the number of shims, spacers and washers being used.
- The thickness of each threaded wear pad insert is 0.312 in (7,92 mm)(**A**).
- The bolt length should be determined by measuring the distance from the face of the insert to the face of the boom (**B**) including any spacer, shim(s) and washer(s).
- Bolt thread engagement in the wear pad insert should be 0.275 ± 0.040 in (6,98 ± 1,0 mm).
- One or two hardened washers are to be used on each wear pad bolt except where noted otherwise. DO NOT use more than two hardened washers.
- Use only one hardened washer if mounting bolts are recessed.
- Wear Pad Bolt Torque:
  3/8 - 24 Bolt, 32 - 37 lb-ft (43 - 50 Nm)
  3/8 - 24 Hollow Bolt, 15 - 17 lb-ft (20 - 23 Nm)
  1/2 - 20 Bolt, 76 - 86 lb-ft (103 - 116 Nm)
  1/2 - 20 Hollow Bolt, 45 - 50 lb-ft (61 - 68 Nm)
- Torque wear pad bolts after shimming is completed.
- Lubricate the face and pockets of each wear pad after being installed.

Boom Section Wear Pad Pathway Lubrication:

- Clean and lightly grease all wear pad pathways with Mystik Tetrimoly grease.

6. Clean and lightly grease the hose carrier guide bar pathways with Mystik Tetrimoly grease.

3.12 BOOM EXTEND AND RETRACT CHAINS

3.12.1 Boom Chain Inspection

⚠ WARNING

Worn pins, stretched or cracked links or corrosive environments can cause chain failure. A chain failure could result in uncontrolled boom movement, loss of load or machine instability.

Under normal operating conditions the boom chains will need to be inspected every 250 hours of operation. The retract chains need to be exposed and inspected every 1000 hours of operation. Environmental conditions and dynamic impulse/shock loads can drastically affect normal operating conditions and require more frequent inspection intervals.

Environments in which material handling vehicles operate can vary widely from outdoor moisture to temperature to mildly corrosive or highly corrosive industrial atmospheres, in addition to abrasive exposures such as sand and grit. Some effects can be as follows:

- Moisture - Corrosive rusting reduces chain strength by pitting and cracking.
- Temperature - Low temperature reduces chain strength by embrittlement. Going in and out of cold storage results in moisture from condensation.
- Chemical Solutions or Vapors - Corrosive attack on the chain components and/or the mechanical connections between the chain components. Cracking can be (and often is) microscopic. Going from microscopic cracking to complete failure can be either abrupt or may require an extended period of time.
- Abrasives - Accelerated wearing and scoring of the articulating members of the chain (pins an d plates), with a corresponding reduction in chain strength. Due to the inaccessibility of the bearing surfaces (pin surfaces and plate apertures), wear and scoring are not readily noticeable to the naked eye.

Following are some examples of dynamic shock loading which can impose abnormal loads above the endurance limit of a leaf chain.

- High velocity movement of load, followed by sudden, abrupt stops.
- Carrying loads in suspension over irregular surfaces such as railroad tracks, potholes, and rough terrain.
- Attempting to “inch” loads which are beyond the rated capacity of the vehicle.

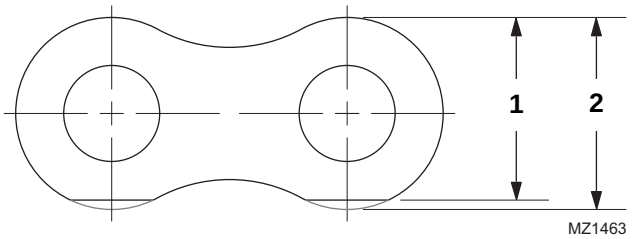
The above load cycles and environmental conditions make it impossible to predict chain life. It is therefore necessary to conduct frequent inspections until replacement life can be predicted.

The boom chain’s normal life expectancy can be expressed as a maximum percent of elongation. This is generally 3%. As the chain flexes back and forth over the sheave, the bearing joints (pins and inside link plates) gradually incur wear due to articulation.

3.12.2 Inspection Guidelines

1. Park the machine on a firm, level surface, raise the boom to a horizontal (level) position, place the transmission control lever in (N) NEUTRAL, engage the park brake switch.
2. Fully extend the boom until the extend chain is taut. Shut the engine off.
3. The extend chains will be visible for inspection with the vehicle in this state.
4. While doing the chain inspection, check all chain clevis ends for distortion or cracking and sheaves for bearing wear or grooving from the chain.
5. Inspect the retract chains every 1000 hours of operation.
6. Inspect the chains for the following conditions:

Edge Wear

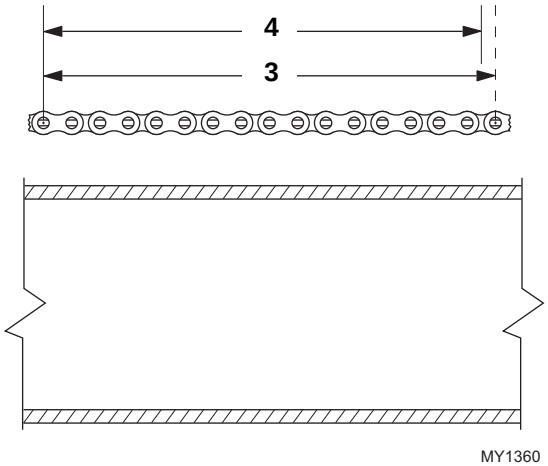


Check the chain for wear on the link plate edges caused by running back and forth over the sheave. The maximum reduction of material should not exceed 5%. Measure and compare to a normal link plate height by measuring a portion of chain that does not run over the sheave. If the measured plate height (**1**) is 5% less than the normal plate height (**2**), discard and replace the chain.

Elongation

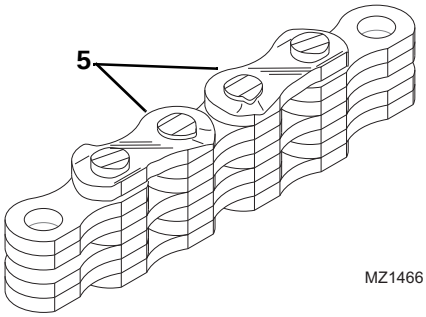
It is important to measure the chain in the section that moves over the sheaves because it receives the most frequent articulation. Measuring the chain near its clevis terminals could give an inaccurate reading. The ends of the chains, near the clevis terminal, will not have flexed as frequently, if at all, as the middle of the chains.

It is best to measure in 12 pin increments from pin center to pin center. For example, if the links are one inch from pin center to pin center, the distance should be 12 in (305 mm). If the links are 3/4 in (19,0 mm) apart, the distance after 12 pins should be 9 in (228,6 mm).



If the distance measured (**3**) is 3% greater than the normal length (**4**), discard and replace the chain.

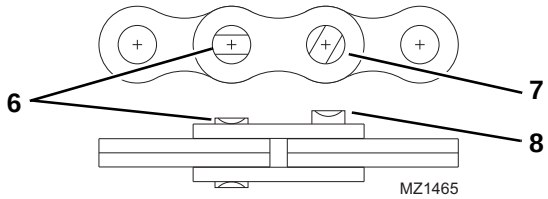
Distorted or Battered Link Plates



Distorted or battered link plates (**5**) on a leaf chain can cause tight joints and prevent flexing.

Turning or Protruding Pins

Highly loaded chain, operating with inadequate lubrication can generate abnormal frictional forces between pin and link plates. When chain is allowed to operate in this condition, a pin or series of pins, can begin to twist out of a chain, resulting in failure.



Examine the pin head rivets to determine if the "VEE" flats are still in correct alignment (**6**). Chain with rotated/displaced heads (**7**) or abnormal pin protrusion (**8**) should be replaced immediately.

DO NOT attempt to repair the chain by welding or driving the pin(s) back into the chain. Once the press fit integrity between outside plates and pins has been altered, it cannot be restored.

Any wear pattern on the pin heads or the sides of the link plates indicates misalignment in the system. This condition damages the chain as well as increases frictional loading and should be corrected.

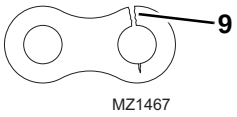
Cracked Plates

Inspect the chains very carefully, front and back as well as side to side, for any evidence of cracked plates. If any one crack is discovered, the chain should be replaced in its entirety.

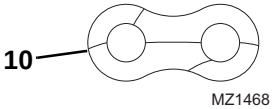
It is important, however to determine the cause of the crack before installing a new chain so the condition does not repeat itself.

The types of cracks are:

- **Fatigue Cracking** - Fatigue cracks (**9**) are a result of repeated cyclic loading beyond the chain's endurance limit.



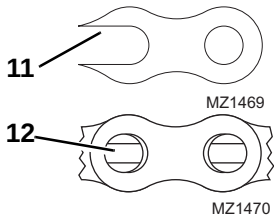
- **Stress Corrosion Cracking** - The outside link plates are particularly susceptible to stress corrosion cracking (**10**).



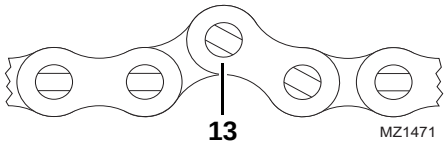
- **Corrosion Fatigue Cracking** - Corrosion fatigue cracks are very similar to fatigue cracks in appearance. Corrosion fatigue is the combined action of an aggressive environment and cyclic stress.

Other Modes of Failure

- **Ultimate Strength Failure** - These types of failures are caused by overloads far in excess of the design load. Either fractured plates (**11**) or enlarged holes (**12**) can occur. If either of these failures occurs, the chain should be replaced immediately.



- **Tight Joints** - All joints in the chain should flex freely. Tight joints (**13**) resist flexing.



If the problem is caused by dirt or foreign substance packed in the joints, clean and lubricate thoroughly before re-installing the chain.
If the problem is caused by corrosion and rust or bent pins, replace the chain.

3.12.3 Expose Chains for Inspection

d. Extend Chains

1. Park the machine on a firm, level surface. Place the transmission control lever in (N) NEUTRAL, engage the park brake switch and raise the boom to a horizontal (level) position.
2. Fully extend the boom until both extend chains are taut. Shut the engine OFF.

The extend chains will be visible for inspection with the machine in this state.

While doing the chain inspection, check all chain clevis ends for distortion or cracking and sheaves for bearing wear or grooving from the chain.

If during the inspection, any chain is found to be damaged or stretched, the chain must be replaced. It is recommended that when any chain is replaced, that all the chains and clevises be replaced at the same time.

e. Retract Chains

The three retract chains are only partially visible through the rear of the boom with all the sections retracted. It is possible to see a section of the retract chain as the boom is slowly extended. If there is ANY question that one or all the retract chains are damaged, the boom should be removed and disassembled with the retract chains being inspected and replaced if necessary.

***Note: DO NOT** attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that all chains and clevis' be replaced at the same time.*

3.12.4 Chain Lubrication

After inspection and before being returned to service, chains must be lubricated with Mystik Tetrimoly Grease.

The lubricant must penetrate the chain joint to prevent wear. Applying lubricant to the external surfaces will prevent rust, but the chains should be articulated to make sure the lubricant penetrates to the working surfaces between the pins and links.

To prepare the chain for lubrication, the chain plates should be brushed with a stiff brush or wire brush to clear the space between the plates so that lubricant can penetrate to the working surfaces.

Lubricant may be applied with a narrow paint brush or directly poured on, but the chain should be well flooded with lubricant and the boom should be extended and retracted to be sure that the lubricant penetrates to the working surfaces. All surplus lubricant should be wiped away from the external surfaces. DO NOT use a solvent for this wiping operation.

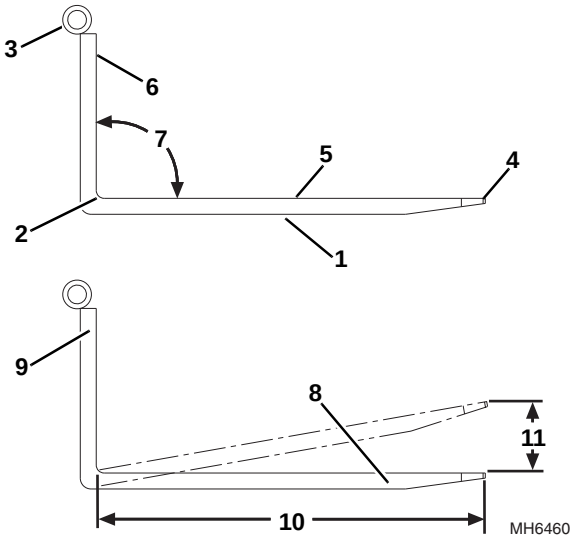
Regular application of lubricant is necessary to make sure that all working surfaces are adequately lubricated. In extremely dusty conditions, it may be necessary to lubricate the chains more often. Refer to Section 2.5, "Service and Maintenance Schedules," and Section 2.6, "Lubrication Schedules," for detailed information.

Lubrication of chains on vehicles working consistently in extreme hot or cold conditions requires special consideration. Contact the local distributor for guidance.

3.13 FORKS

Forks should be cleaned and inspected prior to being attached to carriage. If the following criteria is not met, forks must be removed from service immediately.

Daily Inspection



1. Inspect forks (**1**) for cracks, paying special attention to heel (**2**) and mounting tubes (**3**).
2. Inspect forks for broken or bent tips (**4**) and twisted blades (**5**) and shanks (**6**).

Yearly Inspection

1. Straightness of the upper face of blade (**5**) and the front face of shank (**6**) should not exceed 0.5 percent of the length of blade or height of shank.
2. Angle (**7**) between upper face of blade and front face of shank should not exceed 93 degrees.
3. Thickness of blade (**8**) and shank (**9**) should not be reduced to 90 percent of original thickness.

Note: *Contact the local distributor with the fork part number to find the manufactured dimensions of the fork blade.*

4. Ensure fork length (**10**) is adequate for intended loads.
5. Fork markings should be legible, re-stamp if required.
6. Compare fork tips (**11**) when mounted on a carriage. Maximum difference in height of fork tips is 3 percent of the length of the blade (**10**).

3.14 TROUBLESHOOTING

This section provides an easy reference guide covering the most common problems that occur during operation of the boom.

Problem	Cause	Remedy
1. Boom will not extend or retract	1. Broken hydraulic hose(s) or tube(s) and/or connections leaking.	1. Locate break, replace hose(s) or tube(s), tighten connections.
	2. Extend/retract hydraulic system not operating properly.	2. Refer to Section 8.4, “Hydraulic Circuits.”
	3. Faulty extend/retract cylinder.	3. Repair cylinder, Refer to Section 8.8, “Hydraulic Cylinders.”
2. Boom shifts to right or left when extending.	1. Boom side wear pads improperly shimmed or worn.	1. Shim wear pads to correct gap. Replace wear pads as needed. Refer to Section 3.11, “Boom Wear Pads.”
3. Excessive boom pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. Refer to Section 2.6, “Lubrication Schedules.” Replace worn pins as needed.
	2. Worn bearing(s).	2. Replace bearing(s) and lubricate at regular intervals. Refer to Section 2.6, “Lubrication Schedules.”
4. Excessive Compensation cylinder pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. Refer to Section 2.6, “Lubrication Schedules.” Replace worn pins as needed.
	2. Worn bushing(s).	2. Replace bushing(s) and lubricate at regular intervals.

Problem	Cause	Remedy
5. Drooping chain, or jerky boom extend or retract functions.	1. Chain(s) tension not properly adjusted.	1. Adjust chain(s).
	2. Chain(s) stretched or binding.	2. Replace chains as needed. Refer to Section 3.7, “Boom Section Separation Adjustment.”
	3. Wear pads loose, contaminated, excessively worn or damaged.	3. Replace wear pad. Refer to Section 3.11, “Boom Wear Pads.”
	4. Contaminated, corroded or rusted wear pad sliding surfaces.	4. Remove contamination and/or corrosion from wear pad sliding surfaces and lubricate. If the surfaces cannot be reconditioned, replace the boom section(s).
	5. Extend/Retract hydraulic system not operating properly.	5. Refer to Section 8.4, “Hydraulic Circuits.”
	6. Damaged boom section.	6. Replace the damaged boom section. Refer to Section 3.3, “Boom Assembly Maintenance.”
6. Boom will not raise or lower.	1. Broken hydraulic hoses or tubes and/or connection leaks.	1. Locate break, replace hose(s) or tube(s), tighten connections.
	2. Lift/lower hydraulic system not operating properly.	2. Refer to Section 8.4, “Hydraulic Circuits.”
	3. Faulty lift/lower cylinder.	3. Repair cylinder. Refer toSection 8.8, “Hydraulic Cylinders.”
	4. Seized boom pivot pin bearing.	4. Replace bearing.
7. Excessive Lift/Lower cylinder pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. Refer to Section 2.5, “Service and Maintenance Schedules.” Replace worn pins as needed. Refer to Section 8.8, “Hydraulic Cylinders.”
	2. Worn self-aligning bushing(s).	2. Replace bushing(s) and lubricate at regular intervals. Refer to Section 2.6, “Lubrication Schedules.”

Problem	Cause	Remedy
8. Rapid boom pad wear.	1. Incorrect wear pad gap.	1. Check wear pad gaps and correct as needed. Refer to Section 3.11, “Boom Wear Pads.”
	2. Rapid cycle times with heavy loads.	2. Reduce cycle times.
	3. Contaminated, corroded or rusted wear pad sliding surfaces.	3. Remove contamination and/or corrosion from wear pad sliding surfaces and lubricate. If the surfaces cannot be reconditioned, replace the boom section(s).
	4. Operating in extremely dusty/ abrasive conditions.	4. Clean equipment frequently.
9. Auxiliary hydraulics will not operate.	1. Auxiliary hydraulic system not operating properly.	1. Refer to Section 8.4, “Hydraulic Circuits.”
10. Excessive chain wear.	1. Improper chain adjustment.	1. Adjust to correct tension. Refer to Section 3.7, “Boom Section Separation Adjustment.”- Replace chains as needed.
	2. Chain sheave(s) not properly lubricated.	2. Lubricate chain sheave. (Refer to Section 2.5, “Service and Maintenance Schedules.”
	3. Chain sheave(s) not rotating freely.	3. Lubricate chain sheave. Refer to Section 2.5, “Service and Maintenance Schedules.” Repair or replace chain sheave(s) as needed.
	4. Improper chain lubrication.	4. Lubricate at regular intervals. Refer to Section 2.5, “Service and Maintenance Schedules.” Replace chains as needed.

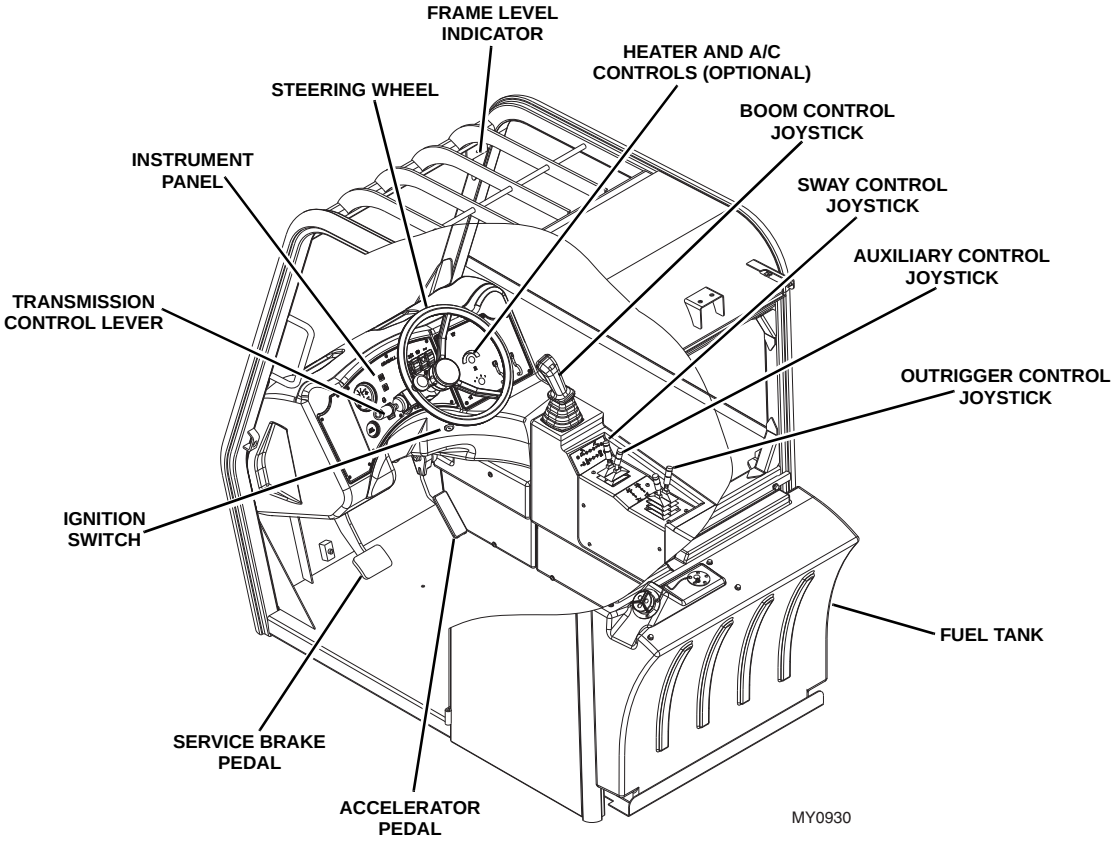
Section 4
Cab and Covers

Contents

PARAGRAPH		TITLE	PAGE
4.1		**Operator's Cab and Covers Component Terminology**	**4-2**
4.2		**Operator's Cab**	**4-3**
	4.2.1	Cab Safety	4-3
	4.2.2	Serial Number Decal	4-3
4.3		**Cab Components**	**4-3**
	4.3.1	Steering Column and Orbitrol Valve	4-3
	4.3.2	Service Brake Pedal	4-4
	4.3.3	Throttle Pedal	4-5
	4.3.4	Boom Joystick Assembly	4-5
	4.3.5	Frame Sway, Auxiliary and Outrigger Control Joysticks	4-6
	4.3.6	Windshield Wiper Assembly	4-6
	4.3.7	Heater/Air Conditioning System (if equipped)	4-6
4.4		**Cab Removal**	**4-8**
4.5		**Cab Installation**	**4-9**

4.1 OPERATOR'S CAB AND COVERS COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the machine cab and covers. The following illustration identifies the components that are referred to throughout this section.



WARNING

DO NOT service the machine without following all safety precautions as outlined in the “Safety Practices” section of this manual.

4.2 OPERATOR’S CAB

4.2.1 Cab Safety

WARNING

The protection offered by this ROPS/FOPS will be impaired if subjected to any modification or structural damage, at which time replacement is necessary. ROPS/FOPS must be properly installed using fasteners of correct size and grade, and torqued to their specified value.

WARNING

DO NOT weld, grind, drill, repair or modify the cab in any way. Any modification or damage to cab structural components requires cab replacement. Refer to page 2-9 in the Operators & Safety Manual.

To help ensure optimum safety, protection and performance, replace the cab if it is damaged. Refer to the appropriate parts manual for ordering information.

4.2.2 Serial Number Decal

The cab serial number decal is located on the left side of the cab, behind the seat. Information specified on the serial number plate includes the cab model number, the cab serial number and other data. Write this information down in a convenient location to use in cab correspondence.

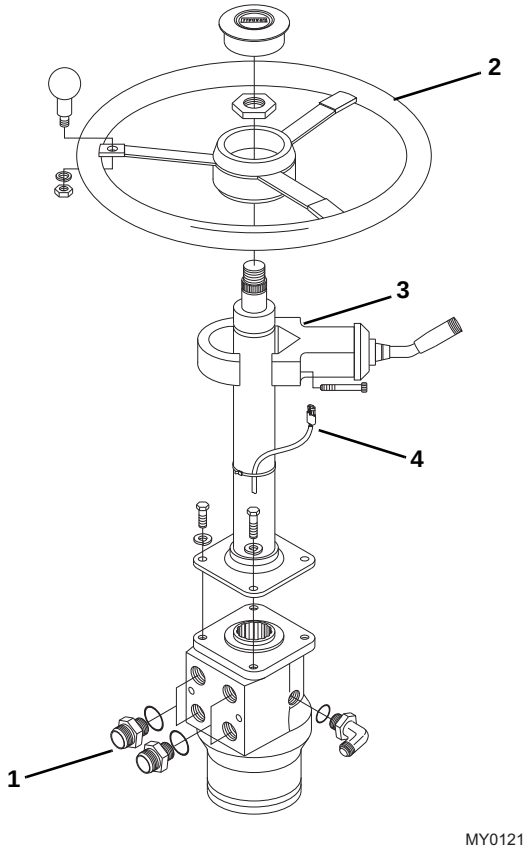
4.3 CAB COMPONENTS

4.3.1 Steering Column and Orbitrol Valve

a. Orbitrol Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.

Note: *It may be necessary to remove the main dash panel to gain access to the appropriate hydraulic hoses. Refer to Section 9.11.1, “Analog Gauges.”*



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5. Label, disconnect and cap the four hoses from the side of the steering valve (**1**). Cap the fittings on the steering valve. Label, disconnect and plug the load sense hose at the front of the steering valve. Cap the fitting on the steering valve.
6. Remove the steering wheel (**2**), disconnect and remove the travel select lever (**3**), disconnect the instrument panel harness connector (**4**).
7. Remove the steering assembly through the dash panel opening.
8. Support the steering valve, and remove the four hex-head capscrews and four lockwashers.

Note: ***DO NOT*** *disassemble the orbitrol valve. The orbitrol valve is not serviceable and must be replaced in its entirety, if defective.*

b. Orbitrol Valve Installation

1. Secure the steering valve to the steering column with four hex-flange capscrews and four lockwashers.
2. Install the steering column through the dash panel opening. Position steering valve to its original orientation in the cab.
3. Install the travel select lever, connect the instrument panel harness connector, install the steering wheel assembly. Torque the steering wheel nut to 29-34 lb-ft (39-46 Nm).
4. Install new o-rings into the steering valve fittings. Lubricate the o-rings with clean hydraulic oil.
5. Uncap and connect the previously labeled load sense hose to the steering valve.
6. Uncap and connect the remaining previously labeled four hoses to the steering valve.

Note: *If necessary, install the main dash panel. Refer to Section 9.11.1, "Analog Gauges."*

7. Properly connect the battery
8. Start the engine and check the operation of steering system. Check for hydraulic fluid leaks. Check the hydraulic fluid level in the tank and add fluid as required.
9. Close and secure the engine cover.

c. Steering Test

Conduct a pressure check of the steering hydraulic circuits at the main control valve. Refer to Section 8.3.1, "Pressure Checks and Adjustments."

4.3.2 Service Brake Pedal

a. Brake Valve Removal

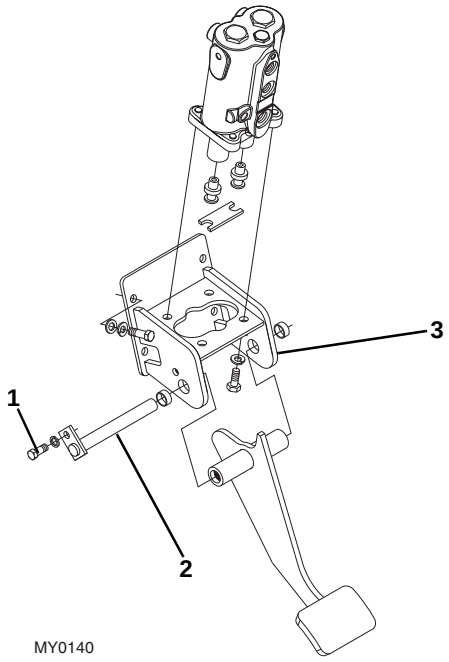
Refer to Section 8.7.3, "Service Brake Valve," for removal information.

b. Brake Valve Installation

Refer to Section 8.7.3, "Service Brake Valve," for installation information.

c. Service Brake Pedal Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Remove the bolt and lockwasher (**1**) securing the service brake pedal pivot pin (**2**).
6. Pull the pivot pin from the service brake pedal bracket (**3**).
7. Remove the service brake pedal from the cab.

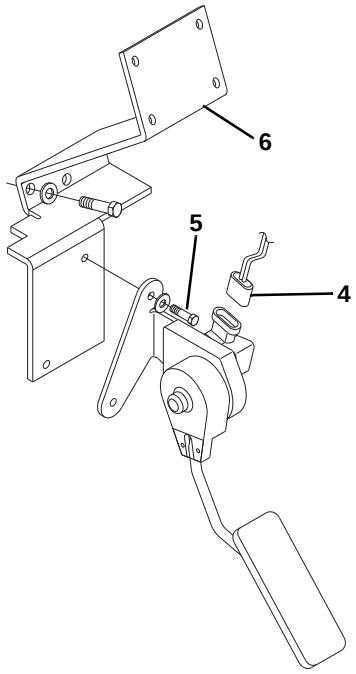
d. Service Brake Pedal Installation

1. Position the service brake pedal in its mounting location within the cab.
2. Secure the brake pedal into position with the pivot pin.
3. Be sure the brake pedal has the correct range of motion. Secure pivot pin with bolt and lockwasher.
4. Properly connect the battery.
5. Close and secure the engine cover.

4.3.3 Throttle Pedal

a. Throttle Pedal Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Properly disconnect the battery.



4. Disconnect the electrical harness connector (**4**).
5. Remove the bolts (**5**) securing the throttle pedal to the throttle pedal bracket (**6**).
6. Remove the throttle pedal assembly from the cab.

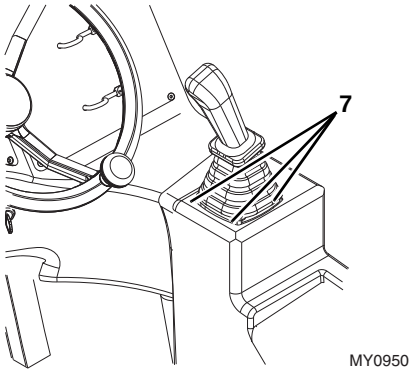
b. Throttle Pedal Installation

1. Position the throttle pedal in its mounting location within the cab.
2. Secure the throttle pedal into position with the pivot pin.
3. Install the throttle pedal ball joint to the throttle pedal.
4. Connect the battery negative (-) cable to the battery negative (-) terminal.
5. Close and secure the engine cover.

4.3.4 Boom Joystick Assembly

a. Boom Joystick Assembly Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Properly disconnect the battery.



4. Lift the joysticks rubber sleeve, remove the bolts securing the boom joystick to the cab console (**7**).
5. Lift the boom joystick from its mounting position.
6. Label, disconnect and cap the hydraulic hoses attached to the boom joystick.
7. Disconnect the electrical harness connector from the joystick.
8. Remove the boom joystick assembly.

b. Boom Joystick Assembly Installation

1. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
2. Connect the electrical harness connector to the joystick.
3. Install the bolts securing the boom joystick to the cab console.
4. Properly connect the battery.
5. Test the boom extend/retract and boom lift/lower joystick function:

a. Move the joystick handle rearward, activating the boom lift function. The boom should RISE.

b. Move the joystick handle forward, activating the boom lower function. The boom should LOWER.

c. Move the joystick handle to the right, activating the boom extend function. The boom should EXTEND.

d. Move the joystick handle to the left, activating the boom retract function. The boom should RETRACT.

e. Depress the left side of the switch (optional) to activate the tilt up function. The attachment should TILT UP.

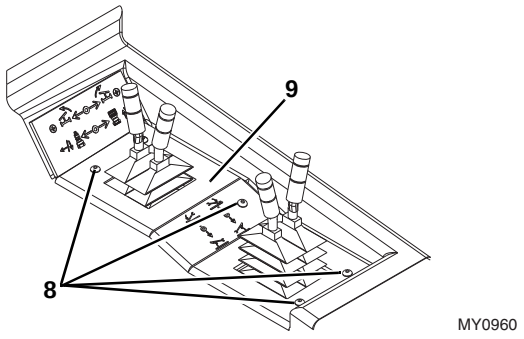
f. Depress the right side of the switch (optional) to activate the tilt down function. The attachment should TILT DOWN.

6. Close and secure the engine cover.

4.3.5 Frame Sway, Auxiliary and Outrigger Control Joysticks

a. Joystick Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Properly disconnect the battery.



4. Remove the screws (**8**) securing the dash panel (**9**) to the cab. Remove the dash panel.
5. Remove any hardware securing the joystick to the cab.
6. Label, disconnect and cap the hydraulic fittings attached to the joystick.
7. Remove the joystick from the cab.

b. Joystick Installation

1. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
2. Install the bolts securing the joystick to the cab.
3. Install the dash panel to its original position with the previously used hardware.
4. Properly connect the battery.
5. Test the complete range of the joystick functions:
6. Close and secure the engine cover.

4.3.6 Windshield Wiper Assembly

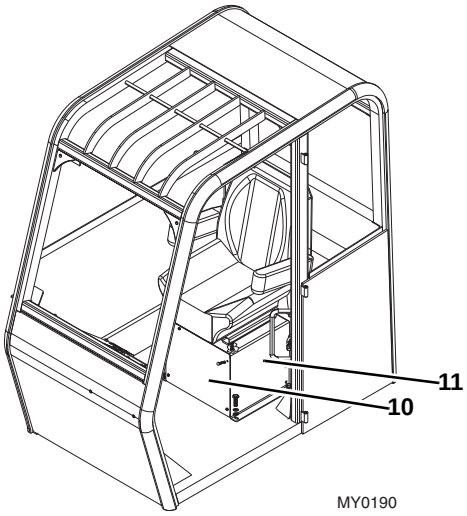
Refer to Section 9.8, “Window Wiper/Washer Windshield Wiper Motor,” for removal and installation information.

4.3.7 Heater/Air Conditioning System (if equipped)

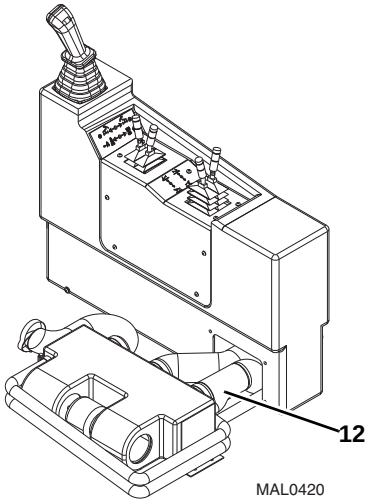
Note: *If machine is equipped with air conditioning, DO NOT loosen or disconnect any air conditioning hoses until the air conditioning system has been properly drained by the local distributor or certified air conditioning service center*.

a. Heater Assembly Removal

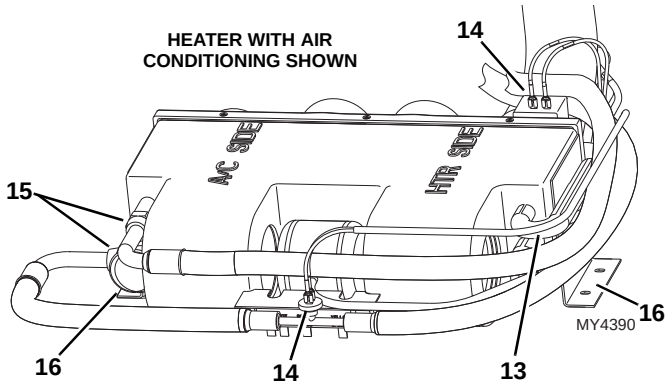
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Place a suitable container beneath the radiator. Slowly turn the radiator cap to the first stop, allow any pressure to escape. Remove the radiator cap.
6. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain petcock and allow the coolant to drain.
7. Transfer the coolant to a container with a cover, and label as “Used Antifreeze.” Dispose of the used coolant at an approved recycling facility.
8. Tighten the radiator drain petcock.
9. Remove the bolts that secure the seat to the cab. Remove the seat.



10. Remove the bolts securing the front plate (**10**) to the seat riser weldment (**11**).
11. Remove the bolts securing the seat riser weldment to the cab. Remove the riser weldment.



12. Loosen the hose and disconnect the heater air duct hoses (**12**).



13. Loose the hose clamps securing the heater hoses (**13**).
14. Label and remove both heater hoses.
15. Label and disconnect any electrical connections (**14**).
16. Label and disconnect both air conditioning hoses (**15**).
17. Remove the bolts (**16**) securing the heater assembly to the cab. Remove the heater assembly.

b. Heater Assembly Installation

Note: *If machine is equipped with air conditioning, the air conditioning system must be charged by the local JLG dealer or certified air conditioning service center*.

1. Position the heater assembly to its original orientation in the cab. Secure with the previous hardware.
2. Connect the previously labeled electrical connections.
3. Connect the previously labeled heater hoses to their appropriate locations.
4. Connect the previously labeled air conditioning hoses to their appropriate locations.
5. Install the seat riser weldment.
6. Install the front plate to the seat riser weldment.
7. Install the cab seat.
8. Fill the cooling system completely with coolant, allowing time for the coolant to fill the engine block. The cooling system capacity is listed in Section 2.4, “Fluid and Lubricant Capacities.”
9. Properly connect the battery.

4.4 CAB REMOVAL

WARNING

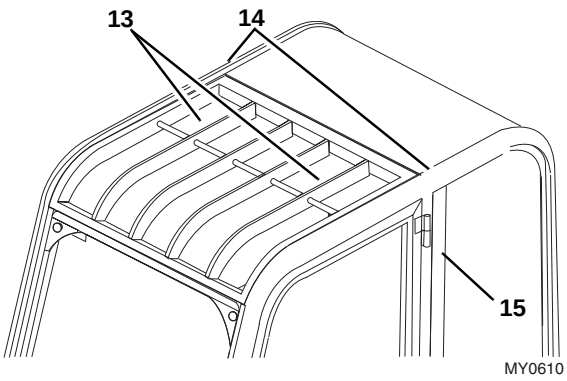
The protection offered by this ROPS/FOPS will be impaired if subjected to any modification or structural damage, at which time replacement is necessary. ROPS/FOPS must be properly installed using fasteners of correct size and grade, and torqued to their specified value.

Note: *To help ensure safety and optimum performance, replace the cab if it is damaged. Refer to the appropriate parts manual for ordering information.*

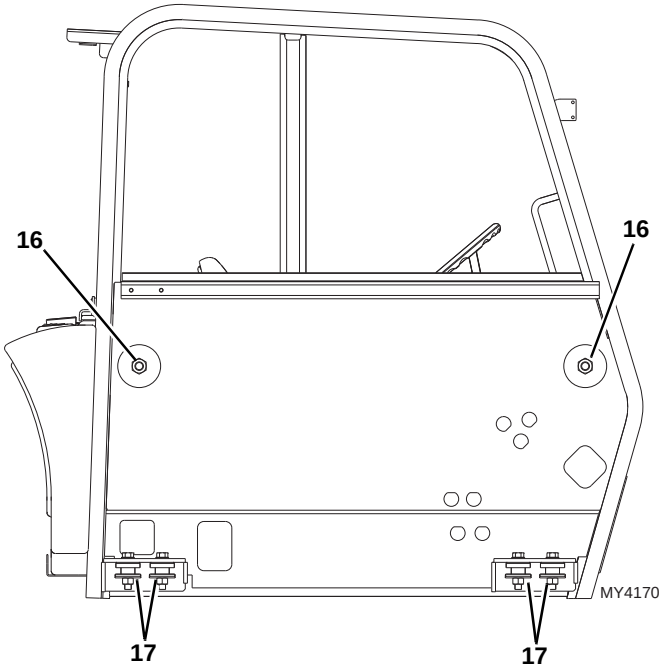
Inspect the cab, its welds and mounts. If modification, damage, a cracked weld and/or fatigued metal is discovered, replace the cab. Contact the local distributor with any questions about the suitability or condition of a cab.

Note: *Remove and label cab components as needed before removing the cab from the machine. Label, disconnect and cap hydraulic hoses. Transfer cab parts to the replacement cab after the replacement cab is securely mounted on the machine.*

1. Park the machine on a firm, level surface. Allow sufficient overhead and side clearance for cab removal. Level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the park brake and shut the engine OFF.
2. Block all four wheels to help prevent the machine from moving. Assure that there is sufficient overhead and side clearance for cab removal.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain petcock and allow the coolant to drain.
6. Transfer the coolant to a container with a cover, and label as “Used Antifreeze.” Dispose of the used coolant at an approved recycling facility.
7. Tighten the radiator drain petcock.
8. Disconnect the cab heater hoses. Refer to Section 4.3.7, “Heater/Air Conditioning System (if equipped).”
9. Remove the necessary dash panels to gain access to the electrical wiring connections. Label and disconnect the harnesses. Push the harness connectors through the opening in the cab.
10. Remove the boom joystick from is mounting position. Refer to Section 4.3.4, “Boom Joystick Assembly.” Label, disconnect and cap all hydraulic hoses attached to the boom joystick. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
11. Remove the frame level and attachment tilt and auxiliary control joystick. Refer to Section 4.3.5, “Frame Sway, Auxiliary and Outrigger Control Joysticks.” Label, disconnect and cap all hydraulic hoses attached to the joystick. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
12. Label, disconnect and cap all hydraulic hoses attached to the steering orbitrol valve. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
13. Label, disconnect and cap all hydraulic hoses attached to the steering orbitrol valve. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
14. Label, disconnect and cap all hydraulic hoses attached to the service brake valve. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
15. Push all the hydraulic hoses through the opening in the cab.
16. Disconnect the throttle cable from the throttle assembly. Refer to Section 4.3.3, “Throttle Pedal.”
17. Disconnect the engine air filter and hydraulic oil reservoir breather from their brackets at the top of the cab. Move the air filter and breather clear from the cab so they do not become damaged during cab removal.
18. Remove the fuel tank from the cab. Refer to Section 7.6.2, “Fuel Tank.”



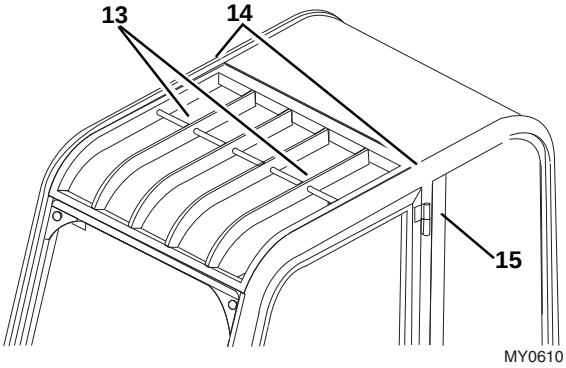
19. Open Cab: Route a sling with a minimum lifting capacity of 1000 lbs (453 kg) under the inner four braces (**13**) and behind the center cross support above the wind shield or install two lifting eye bolts (**14**) in the threaded holes on the roof of the cab above the B pillars (**15**).
20. Enclosed Cab: Install two lifting eye bolts (**14**) in the threaded holes on the roof of the cab above the B pillars (**15**). Route a sling with a minimum lifting capacity of 1000 lbs (453 kg) through the lifting eye bolts.



21. Remove the two cab side-mount bolts in the cab (**16**).
22. Remove the four cab-to-frame bolts, flat washers and nuts (**17**).
23. Remove the mirrors and all other cab components as needed, if not previously removed.
24. Carefully begin to lift the cab. Stop and check that all wiring, hydraulic hoses and fasteners are disconnected or removed.
25. When all wiring, hydraulic hoses and fasteners are disconnected or removed, carefully and slowly lift the cab and remove it from the frame. Readjust the position of the sling as needed to help balance the cab during removal.
26. When the cab is completely clear of the machine, carefully lower it to the ground. Block up or support the cab so that it does not move or fall. Assure that no personnel enter the cab while it is being removed from the machine.
27. Inspect the condition of the fittings, clamps, hydraulic hoses, etc. Replace parts as indicated by their condition.
28. Inspect and replace other machine parts that are exposed with the cab removed. Repair or replace as required.

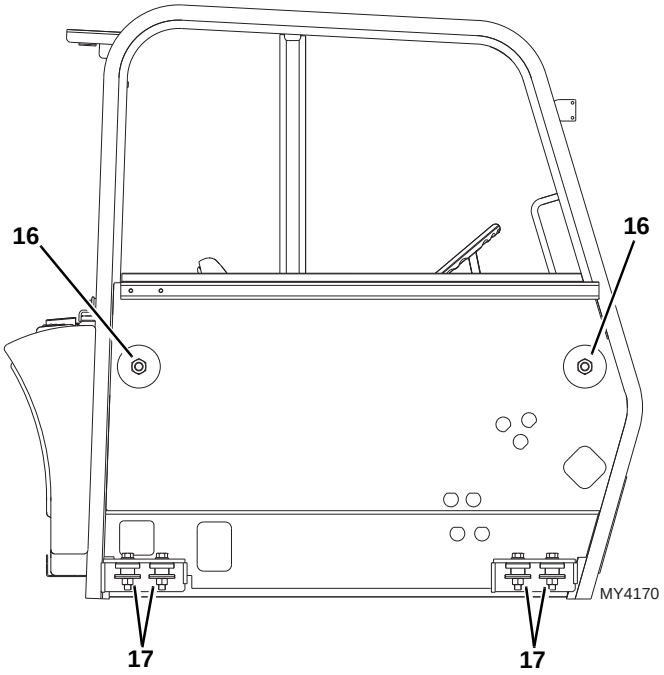
4.5 CAB INSTALLATION

1. Block all four wheels to help prevent the machine from moving. Assure that there is sufficient overhead and side clearance for cab installation.



2. Open Cab: Route a sling with a minimum lifting capacity of 1000 lbs (453 kg) under the inner four braces (**13**) and behind the center cross support above the wind shield or install two lifting eye bolts (**14**) in the threaded holes on the roof of the cab above the B pillars (**15**).
3. Enclosed Cab: Install two lifting eye bolts (**14**) in the threaded holes on the roof of the cab above the B pillars (**15**). Route a sling with a minimum lifting capacity of 1000 lbs (453 kg) through the lifting eye bolts.

4. Use a hoist or overhead crane and sling attached to the cab. Carefully begin to align the cab with the mounting holes in the frame. Stop and check that wiring, hydraulic hoses, cables, etc., will not be pinched or damaged as the cab is positioned. Readjust the position of the sling as needed to help balance the cab during installation.



5. Install the four cab-to-frame mount bolts, washers and nuts (**17**). Torque to 280-305 lb-ft (379-414 Nm).
6. Install the two cab side mount bolts washers and nuts (**16**). Torque to 680-720 lb-ft (922-976 Nm).
7. Install the engine air filter and hydraulic oil reservoir breather to their brackets at the top of the cab.
8. Install the throttle cable to the throttle pedal assembly. Refer to Section 4.3.3, “Throttle Pedal.”
9. Pull all the hydraulic hoses and electrical wires through the cab.
10. Uncap and reconnect the previously labeled hydraulic hoses to their appropriate locations.
11. Reconnect the previously labeled electrical connections to their appropriate locations.
12. For machines equipped with the heater option, reconnect the heater hoses to the cab heater. Refer to Section 4.3.7, “Heater/Air Conditioning System (if equipped).”
13. Install the fuel tank to the cab. Refer to Section 7.6.2, “Fuel Tank.”
14. Fill the cooling system completely with coolant, allowing time for the coolant to fill the engine block. The cooling system capacity is listed in Section 2.4, “Fluid and Lubricant Capacities.”
15. Properly connect the battery.
16. Start the engine and check the operation of all controls. Check for hydraulic fluid leaks. Check the hydraulic fluid level in the tank and add fluid as required.

Note: *When the engine is initially started, run it briefly at low idle and check the machine for any visual sign of fluid leakage. STOP the engine immediately if any leakage is noted, and make any necessary repairs before continuing.*

17. Wait for the engine to cool and check the coolant level. Add coolant to the overflow bottle as required to bring the coolant to the proper level.
18. Install the mirrors and all other cab components as needed, if removed.
19. Close and secure the engine cover.
20. Unblock the wheels.
21. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

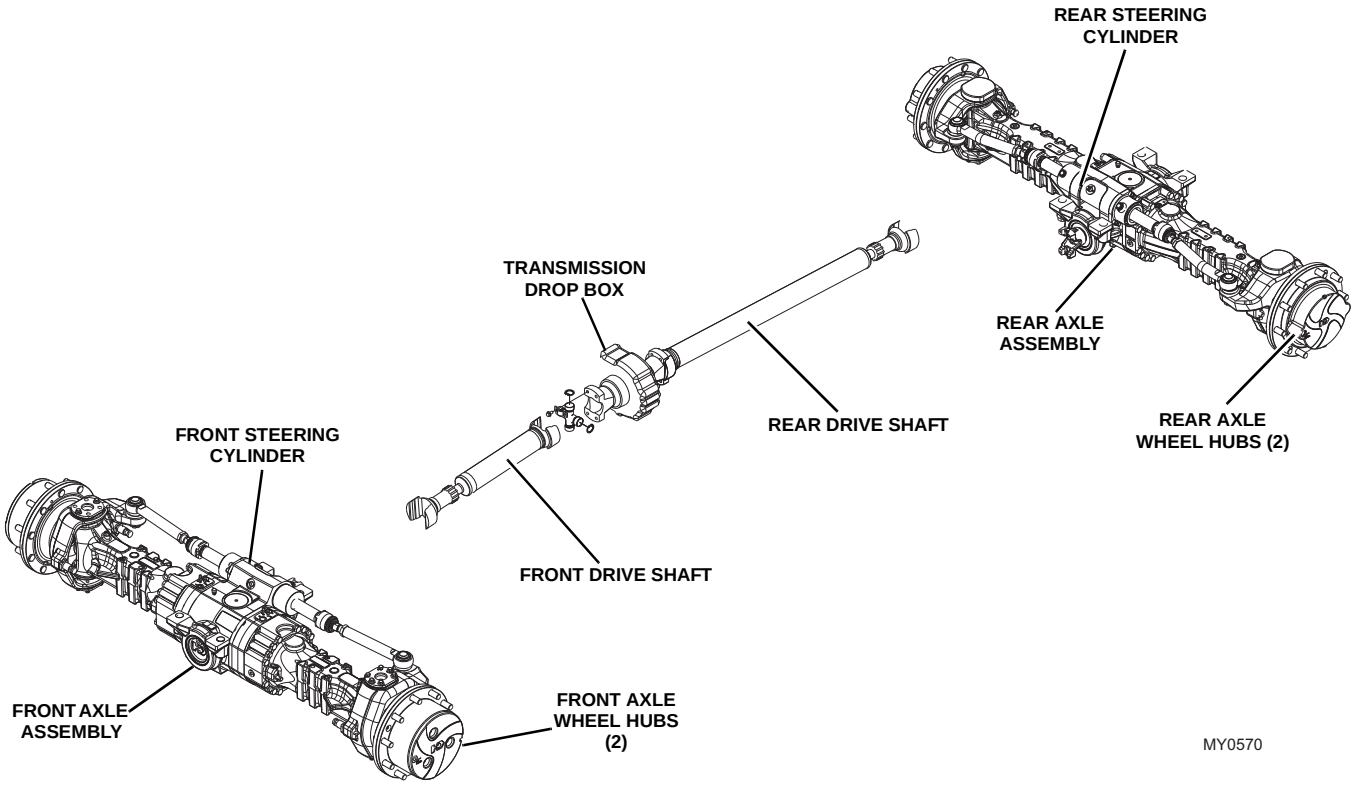
Section 5
Axles, Drive Shafts, Wheels and Tires

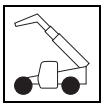
Contents

PARAGRAPH		TITLE	PAGE
5.1		**Axle, Drive Shaft and Wheel Component Terminology**	**5-2**
5.2		**General Information**	**5-3**
5.3		**Axle Assemblies**	**5-3**
	5.3.1	Axle Serial Number Plate	5-3
	5.3.2	Axle Specifications	5-3
	5.3.3	Axle Internal Service	5-3
	5.3.4	Axle Maintenance	5-3
	5.3.5	Axle Removal	5-4
	5.3.6	Axle Installation	5-4
	5.3.7	Axle Assembly and Drive Shaft Troubleshooting	5-6
5.4		**Drive Shafts**	**5-9**
	5.4.1	Drive Shaft Inspection and Service	5-9
	5.4.2	Drive Shaft Maintenance	5-9
	5.4.3	Drive Shaft Removal	5-9
	5.4.4	Drive Shaft Cleaning and Drying	5-9
	5.4.5	Drive Shaft Installation	5-9
5.5		**Wheels and Tires**	**5-10**
	5.5.1	Removing Wheel and Tire Assembly from Machine	5-10
	5.5.2	Installing Wheel and Tire Assembly onto Machine	5-11
5.6		**Brakes**	**5-11**
5.7		**Towing a Disabled machine**	**5-11**
	5.7.1	Manually Releasing the Park Brake	5-11
	5.7.2	Manually Resetting the Park Brake	5-12

5.1 AXLE, DRIVE SHAFT AND WHEEL COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the axles, drive shafts, wheels and tires. The following illustration identifies the components that are referred to throughout this section.





5.2 GENERAL INFORMATION

WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual.

Note: *To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.*

Before performing any inspection, maintenance or service operation, thoroughly clean the unit. The axles and drive shafts should be checked and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Use suitable products to thoroughly clean all disassembled mechanical parts to help prevent personal injury to the worker and prevent damage to the parts. Carefully inspect the integrity of all moving parts (bearings, yokes, tubes, gears, shafts, etc.) and fasteners (nuts, bolts, washers, etc.) as they are subject to major stress and wear. Always replace elastic locknuts and any damaged, worn, cracked, seized or otherwise improper parts that could affect the safe and proper functioning of the machine, axles and drive shafts.

5.3 AXLE ASSEMBLIES

5.3.1 Axle Serial Number Plate

The front and rear axle serial number plate is located on a mounting pad on the front side of the center section of each axle. Information on the serial number plate is required in correspondence regarding the axle.

Supply information from the axle serial number plate when communicating about an axle assembly or axle components.

5.3.2 Axle Specifications

General axle specifications are found in Section 2, “General Information and Specifications.”

5.3.3 Axle Internal Service

Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the Axle Repair Manual (P/N 31200240).

5.3.4 Axle Maintenance

CLEANING: Clean parts with machined or ground surfaces (such as gears, bearings and shafts) with emulsion cleaners or petroleum-based cleaners. **DO NOT** steam clean internal components and the interior of the planetary hub and axle housing. Water can cause corrosion of critical parts. Rust contamination in the lubricant can cause gear and bearing failure. Remove old gasket material from all surfaces.

DRYING: Use clean, lintless towels to dry components after cleaning. **DO NOT** dry bearings by spinning them with compressed air; this can damage mating surfaces due to lack of lubrication. After drying, lightly coat components with oil or a rust-preventive chemical to help protect them from corrosion. If storing components for a prolonged period, wrap them in wax paper.

PERIODIC OPERATION REQUIREMENT: Every two weeks, drive the machine far enough to cause the drive-train components to make several complete revolutions. This will help ensure that internal components receive lubrication to minimize deterioration caused by environmental factors such as high humidity.

SUBMERSION: If the machine has been exposed to water deep enough to cover the hubs, disassemble the wheel ends and inspect for water damage and contamination. If the carrier housing was submerged in water, especially if the water level was above the vent tube (breather), drain the axle and inspect internal parts for water damage and contamination. Before assembling and refilling the unit with the specified lubricant(s), clean, examine and replace damaged parts as necessary.

Note: *Use a suitable puller for bearing removal. Clean, inspect and lubricate all bearings just prior to reassembly. If replacement of a damaged bearing cup or cone is necessary, replace the cup and cone as a set.*

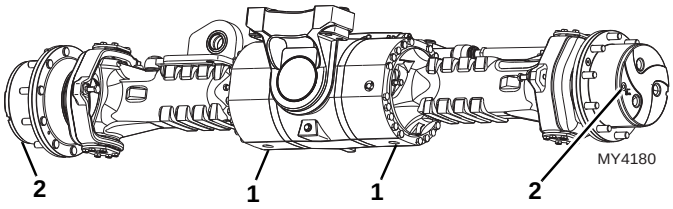
5.3.5 Axle Removal

The front and rear axle assemblies differ in that the front axle assembly is equipped with a parking brake mechanism and a limited-slip feature; the rear axle has neither. The following steps outline a typical axle removal procedure, suitable for either the front or the rear axle assembly.

Cleanliness is extremely important. Before attempting to remove the axle, thoroughly clean the machine. Avoid spraying water or cleaning solution on electrical components. If using a steam cleaner, seal all openings before steam cleaning.

Note: *Clear the work area of all debris, unnecessary personnel, etc. Allow sufficient space to raise the machine and to remove the axle.*

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, straighten all wheels and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the optional fender assembly.



6. If the axle will be disassembled after removal, place a suitable receptacle under the axle (**1**) and wheel hubs drain plugs (**2**). Remove the drain plugs and allow the axle oil to drain into the receptacle. Transfer the used axle oil into a suitable covered container, and label the container as “Used Oil.” Dispose of used oil at an approved recycling facility.
7. Label, disconnect and cap the steering and brake lines at the axle. Wipe up any spilled oil.
8. Block the front and rear of both tires on the axle that is not being removed. Ensure that the machine will remain in place during axle removal before proceeding.
9. Raise the machine using a suitable jack or hoist. Place suitable supports under both sides of the frame and lower the machine onto the supports. Ensure that the machine will remain in place during axle removal.
10. Support the axle that is being removed with a suitable jack, hoist or overhead crane and sling. **DO NOT** raise the axle or the machine.
11. Remove both wheel and tire assemblies from the axle that is being removed. (Refer to Section 5.5.1, “Removing Wheel and Tire Assembly from Machine.”)

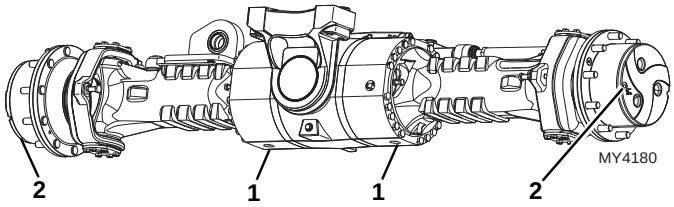
Note: *The wheel and tire assemblies must be re-installed later with the directional tread pattern “arrows” facing in the direction of forward travel.*

12. Remove the drive shaft assembly. Refer to Section 5.4.3, “Drive Shaft Removal.”
13. On the front axle remove the capscrew and locknuts securing the lower position cylinder-mount pin to the front cylinder. Tap the cylinder mount pin out, and move the cylinder to prevent it from interfering with axle removal.
14. Remove the bolts and locknuts securing the axle to the frame.
15. Remove the axles from the machine using the jack, hoist or overhead crane and sling supporting the axle. **DO NOT** raise or otherwise disturb the machine while removing the axle. Balance the axle and prevent it from tipping, turning or falling while removing it from beneath the machine. Place the axle on a suitable support or holding stand.

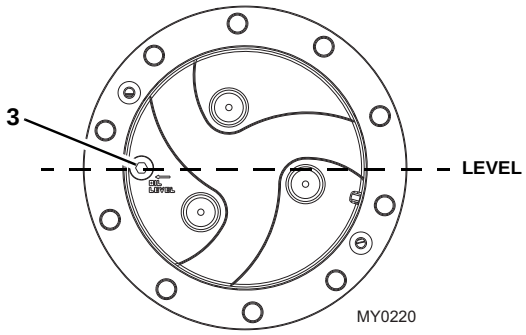
5.3.6 Axle Installation

1. Before proceeding, ensure that the machine will remain in place during axle installation. Block the front and rear of both tires on the axle that is already installed on the machine.
2. If applicable, raise the machine using a suitable jack or hoist. Place suitable supports beneath the frame and lower the machine onto the supports, allowing enough room for axle installation. Ensure that the machine will remain in place during axle installation.

3. Using a suitable jack, hoist or overhead crane and sling, remove the axle from its support or holding stand. Balance the axle and prevent it from tipping, turning or falling while positioning it beneath the machine. **DO NOT** raise or otherwise disturb the machine while installing the axle. Keep the axle supported and balanced on the jack, hoist or overhead crane and sling throughout the installation procedure.
4. Position the axle under the frame, and align the axle housings with the holes in the frame.
5. Install the four axle bolts and nuts. Tighten and torque to 530-565 lb-ft (718-766 Nm).
6. Move the cylinder into position on the axle cylinder anchor. Insert a cylinder-mount pin through the cylinder and cylinder anchor. Secure the cylinder-mount pin with one capscrew and a new locknut.
7. Apply multi-purpose grease through the self-tapping lube fitting to lubricate the self-align bearing and the cylinder-mount pin.
8. Install the drive shaft assemblies. (Refer to Section 5.4.5, “Drive Shaft Installation.”)
9. If reinstalling an axle previously removed from the machine, position the driveshaft yoke on the axle according to the alignment marks made earlier. If installing a new axle, note the position of the driveshaft yoke at the transmission. Align the driveshaft yoke on the axle in the same plane as the yoke on the transmission.



10. Tighten the axle oil drain plug, loosen and remove the axle oil fill plug (**1**). (Refer to Section 2.4, “Fluid and Lubricant Capacities,” for proper oil and capacities.



11. Rotate wheel hubs 90 degrees so the drain plug (**2**) becomes the fill plug (**3**). Refer to Section 2.4, “Fluid and Lubricant Capacities,” for proper oil and capacities.
12. Install the wheel and tire assemblies. Refer to Section 5.5.2, “Installing Wheel and Tire Assembly onto Machine.”
13. Carefully remove the jack, hoist or overhead crane and sling supporting the axle.
14. Carefully raise the machine using a suitable jack or hoist. Remove the supports from beneath the frame and lower the machine to the ground.
15. Remove the blocks from the front and rear of both tires on the other axle.

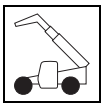
Note: *ALWAYS use new o-rings when servicing the machine.*

16. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
17. Uncap and connect the steering and brake lines at their axle fittings.
18. Check the hydraulic reservoir oil level.
19. Start the engine. Turn the steering wheel several times lock to lock, operate the frame tilt function several times in both directions and check the function of the brakes. Check for hydraulic leaks, and tighten or repair as necessary.
20. Install the optional fender assembly.
21. Close and secure the engine cover.
22. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

Note: *The service brake and parking brake circuits will need to bled after axle installation. Refer to Section 8.7.4, “Service Brake Bleeding.”*

5.3.7 Axle Assembly and Drive Shaft Troubleshooting

Problem	Cause	Remedy
1. Excessive axle noise while driving.	1. Oil level too low.	1. Fill oil to correct level. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	2. Axle and/or wheel end housings filled with incorrect oil or oil level low.	2. Drain axle and/or wheel end housings and fill to correct level with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	3. Incorrect alignment of ring and pinion gears.	3. Correct alignment by adding or removing shims as needed.
	4. Incorrect pinion (input) shaft bearing preload.	4. Correct bearing preload by adding or removing shims as needed.
	5. Worn or damaged bearings.	5. Replace bearings as needed.
	6. Worn or broken gear teeth.	6. Replace gears as needed.
	7. Contamination in the axle.	7. Drain axle and/or wheel end housings and fill to correct level with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	8. Axle housing damaged.	8. Replace damaged parts.
2. Intermittent noise when traveling.	1. Universal joint(s) worn or damaged.	1. Repair or replace universal joints as needed.
	2. Differential ring and/or pinion gears damaged.	2. Determine cause and repair as needed.
3. Vibration or intermittent noise when traveling.	1. Drive shaft universal joint assembly(ies) incorrectly tightened.	1. Tighten capscrews to correct torque.
	2. Drive shaft universal joint(s) worn or damaged.	2. Repair or replace universal joints as needed.
	3. Drive shaft(s) damaged/ unbalanced.	3. Replace drive shaft(s) as needed.



Problem	Cause	Remedy
4. Oil leaking from axle (differential housing and/or axle housings).	1. Drain and/or inspection plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. Hose fittings loose.	2. Tighten fittings.
	3. Axle shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or joint coupling fork shaft (axle shaft).
	4. Input shaft multi-seal ring damaged or missing and/or worn or damaged pinion (input) shaft sealing surfaces.	4. Replace multi-seal ring and/or input shaft. Adjust ring and pinion alignment and bearing preload as described in the Engine Repair Manual.
	5. Axle casing to brake housing and/or brake housing to differential assembly o-rings and/or seals worn or damaged.	5. Replace o-rings and seals.
	6. Axle housing mounting nuts and capscrews loose.	6. Tighten housing nuts and capscrews to 288 lb-ft (390 Nm).
	7. Differential and/or axle housing(s) damaged.	7. Replace housing(s) as needed.
5. Oil leaking from wheel end housing (planet carrier).	1. Oil level plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. O-ring between hub and housing (planet carrier) damaged or missing.	2. Replace o-ring.
	3. Shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or fork joint shaft.
	4. Housing capscrews loose.	4. Tighten housing capscrews to 41 lb-ft (55 Nm).
	5. Housing (planet carrier) damaged.	5. Replace housing (planet carrier).
6. Oil leaking from steering cylinder.	1. Hose fittings loose.	1. Tighten fittings.
	2. Steering cylinder o-rings and/or seals worn or damaged.	2. Replace o-rings and seals.
	3. Piston rod seal worn or damaged.	3. Replace piston rod seal.
	4. Cylinder tube damaged.	4. Replace cylinder tube.

Problem	Cause	Remedy
7. Axle overheating.	1. Oil level too high.	1. Fill oil to correct level with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	2. Axle and/or wheel end housings filled with incorrect oil or oil contaminated or oil level low.	2. Drain axle and fill to correct level with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	3. Dragging park brake.	3. Adjust park brake cable as needed.
8. High steering effort required.	1. Steering (hydraulic) system not operating properly.	1. Refer to Section 8.4, “Hydraulic Circuits.”
	2. Excessive joint housing swivel bearing preload.	2. Correct bearing preload by adding or removing shims as needed.
	3. Worn or damaged swivel bearings.	3. Replace swivel bearings as needed.
9. Slow steering response.	1. Steering (hydraulic) system not operating properly.	1. Refer to Section 8.4, “Hydraulic Circuits.”
	2. Steering cylinder leaking internally.	2. Repair or replace steering cylinder as needed.
10. Excessive noise when brakes are engaged.	1. Brake discs worn.	1. Check brake discs for wear. Refer to Section 5.6, “Brakes.”
	2. Brake discs damaged.	2. Replace brake discs.
11. Brakes will not engage.	1. Brake (hydraulic) system not operating properly.	1. Refer to Section 8.4, “Hydraulic Circuits.”
	2. Brake piston o-rings and seals damaged (leaking).	2. Replace o-rings and seals.
12. Brakes will not hold the machine or braking power reduced.	1. Brake discs worn.	1. Check brake discs for wear. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	2. Brake (hydraulic) system not operating properly.	2. Refer to Section 8.4, “Hydraulic Circuits.”
	3. Brake piston o-rings and seals damaged (leaking).	3. Replace o-rings and seals.

5.4 DRIVE SHAFTS

5.4.1 Drive Shaft Inspection and Service

Whenever servicing the machine, conduct a visual inspection of the drive shafts and cross and bearing assemblies (universal joints, or U-joints). A few moments spent doing this can help prevent further problems and down time later.

Inspect areas where the drive shaft flange yokes and slip yokes mount to the drive shafts. Attempt to turn each drive shaft in both directions. Look for excessive looseness, missing parts, cracks or other damage. Worn or damaged drive shafts and cross and bearing assemblies may cause an excessive amount of vibration or noise.

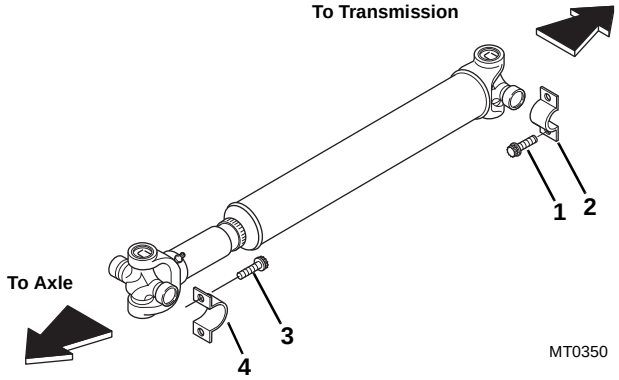
Note: *Any bolt removed from the drive shaft assembly MUST be replaced. Do Not re-torque.*

5.4.2 Drive Shaft Maintenance

Refer to Section 2.4, “Fluid and Lubricant Capacities.” for information regarding the lubrication of the grease fittings on the drive shafts.

5.4.3 Drive Shaft Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Block the wheels.
6. The drive shaft assembly is a balanced assembly. Mark the yoke and axle, transmission and the shaft and slip yoke so that these components can be returned to their original positions when reinstalled. Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.



7. Remove the four bolts (**1**) and two straps (**2**) securing the bearing cross to the transmission output shaft flange. Discard bolts.
8. Remove the four bolts (**3**) and two straps (**4**) securing the bearing crosses to the axle. Discard bolts.
9. Remove the front drive shaft assembly.
10. Repeat the above procedure on the rear drive shaft.

5.4.4 Drive Shaft Cleaning and Drying

1. Disassemble and clean all parts using an approved cleaning fluid. Allow to dry.
2. Remove and burrs or rough spots from all machined surfaces. Re-clean and dry as required.

5.4.5 Drive Shaft Installation

1. Raise the drive shaft assembly into position. The slip-yoke end of the drive shaft mounts toward the axle. If reinstalling a drive shaft previously removed, align the flange yokes according to the alignment marks made during removal.

Note: *The yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.*

2. Apply Loctite® 242 to all mounting bolts.
3. Install the two straps (**2**) and four new bolts (**1**) securing the bearing crosses to the transmission. Torque bolts to 55-60 lb-ft (75-81 Nm).
4. Install the two straps (**4**) and four new bolts (**3**) securing the bearing crosses to the axle. Torque bolts to 55-60 lb-ft (75-81 Nm).
5. Repeat the above procedure on the rear drive shaft.
6. Properly connect the battery.
7. Close and secure the engine cover.
8. Unblock the wheels.
9. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

5.5 WHEELS AND TIRES

WARNING

Mismatched tire sizes, ply ratings or mixing of tire types (radial tires with bias-ply tires) may compromise machine stability and may cause machine to tip over.

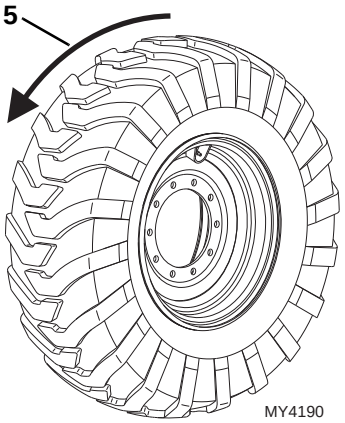
It is recommended that a replacement tire to be the same size, ply and brand as originally installed. Refer to the appropriate parts manual for ordering information. If not using an approved replacement tire, It is recommended that replacement tires have the following characteristics:

- Equal or greater ply/load rating and size of original.
- Tire tread contact width equal or greater than original.
- Wheel diameter, width and offset dimensions equal to the original.
- Approved for the application by the tire manufacturer (including inflation pressure and maximum tire load).

The rims installed have been designed for stability requirements which consist of track width, tire pressure and load capacity. Size changes such as rim width, center piece location, larger or smaller diameter, etc., without written factory recommendations, may result in unsafe condition regarding stability.

Foam filled tires have a positive effect on the weight, stability and handling characteristics of the machine, especially under load. The use of hydrofill as a tire-fill substance is not recommended because of possible environmental impact.

Large-bore valve stems are used to help expedite tire inflation and deflation. An inner tube may be used if a tire does not provide an airtight seal. Check tire inflation pressures when the tires are cold. When mounting a tire on the wheel, the tire must be mounted on the wheel respective of the directional tread pattern of the tire; this produces a left or right tire and wheel assembly.



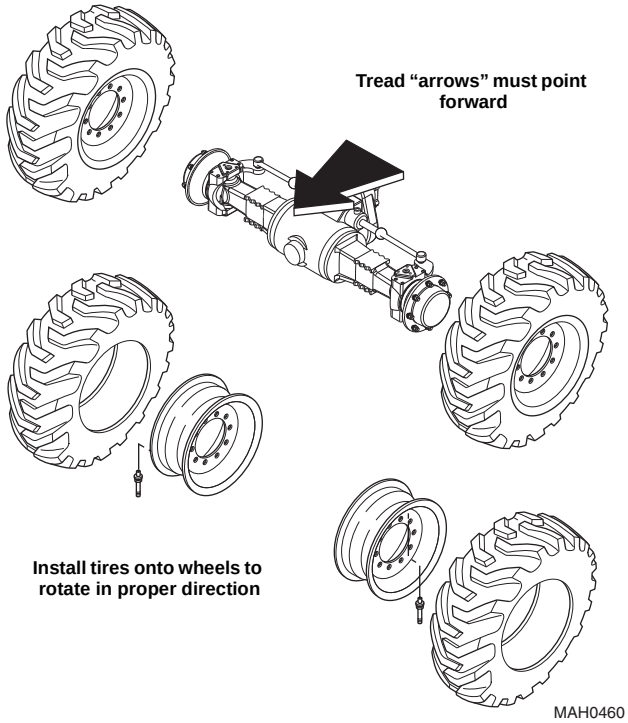
The wheel and tire assemblies must be installed with the directional tread pattern “arrows” (**5**) facing in the direction of forward travel.

5.5.1 Removing Wheel and Tire Assembly from Machine

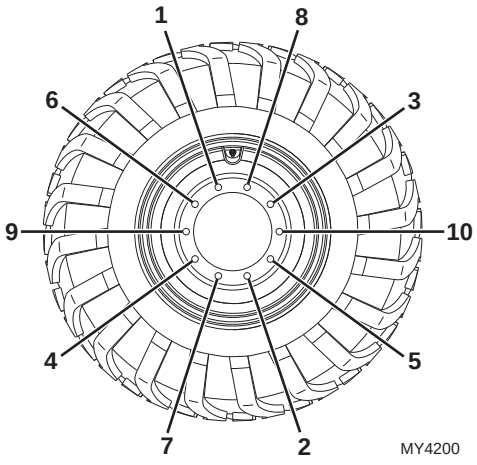
1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place an Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Loosen but **DO NOT** remove the lug nuts on the wheel and tire assembly to be removed.
4. Place a suitable jack under the axle pad closest to the wheel being removed. Raise the machine and position a suitable support beneath the axle. Allow sufficient room to lower the machine onto the support and to remove the wheel and tire assembly.
5. Lower the machine onto the support.
6. Remove lug nuts and lug washers in an alternating pattern.
7. Remove the wheel and tire assembly from the machine.

5.5.2 Installing Wheel and Tire Assembly onto Machine

Note: *The wheel and tire assemblies must be installed with the directional tread pattern "arrows" facing in the direction of forward travel.*



1. Position wheel onto studs on wheel end of axle.
2. Install wheel lug washers.
3. Start all nuts by hand to prevent cross threading. DO NOT use a lubricant on threads or nuts.



4. Tighten lug nuts in an alternating pattern as indicated in figure. Torque to 350-400 lb-ft (475-542 Nm).
5. Remove machine from supports.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

5.6 BRAKES

Check the brake disks for wear every 1,000 hours of operation or yearly.

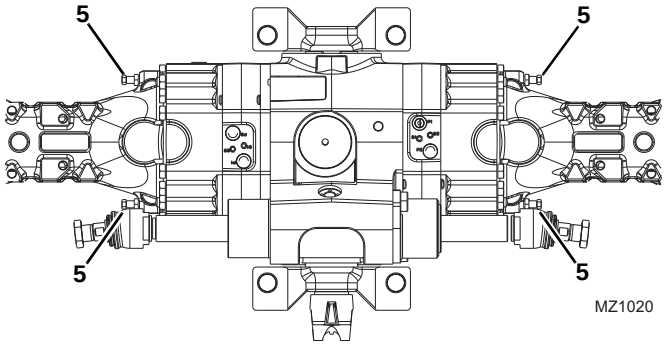
For more information on brake disk inspection, refer to the Axle Repair Manual (P/N 31200240).

5.7 TOWING A DISABLED MACHINE

Towing a disabled machine should only be attempted as a last resort, after exhausting all other options. Make every effort to repair the machine, and move it under its own power, before using the emergency towing procedures outlined below.

Note: *Block the wheels of the machine BEFORE attempting to release the park brake. Once the park brake is released the machine's park brake AND service brakes are inoperable.*

5.7.1 Manually Releasing the Park Brake

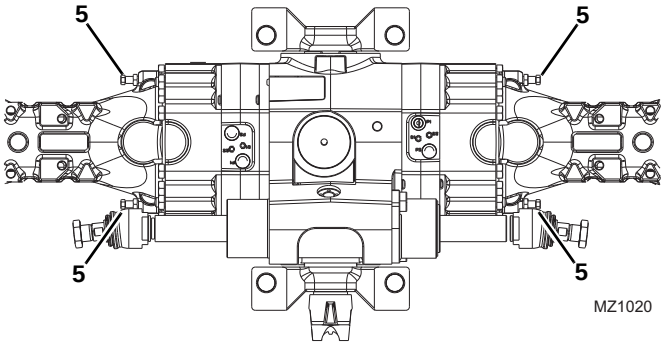


1. Loosen the nuts of the screws (**5**) for the manual release of the braking units. Draw the nuts back approximately 6 mm.
2. Tighten the screws until they are gently seated on the driving plate
3. Carefully tighten each release screw a 1/4 turn at a time in sequence until all have been turned on full turn 360°.
4. Repeat steps 1 thru 3 for the other side of the differential.

Note: *After the machine has been towed to a secure location, reactivate the parking brake. Carefully follow the procedures from start to finish. Contact the local distributor if you are unsure about any part of the procedure, or for specific instructions concerning your particular situation.*

5.7.2 Manually Resetting the Park Brake

Note: *Block the wheels of the machine BEFORE attempting to reset the machine's park brake. Once the park brake is released the machine's park brake AND service brakes are inoperable.*



1. Loosen each release screw (**5**), only 1/4 turn at a time, in sequence, until each screw has lost contact with the guide pin.
2. Remove the screws along with the nuts and seals. Replace the seals, lubricate the screws with a silicone-based grease and re-install the screws along with the nuts.
3. Adjust the nut of the screw heads in relation to the arm by 1.18 in (30 mm).
4. Repeat steps 1 thru 3 for the other side of the differential.
5. After repairs to the machine have been made, start the machine and check the park brake and service brakes for proper function. Refer to Section 8.7.4, "Service Brake Bleeding," Section 8.7.5, "Service Brake Test," and Section 8.7.6, "Park Brake Test."

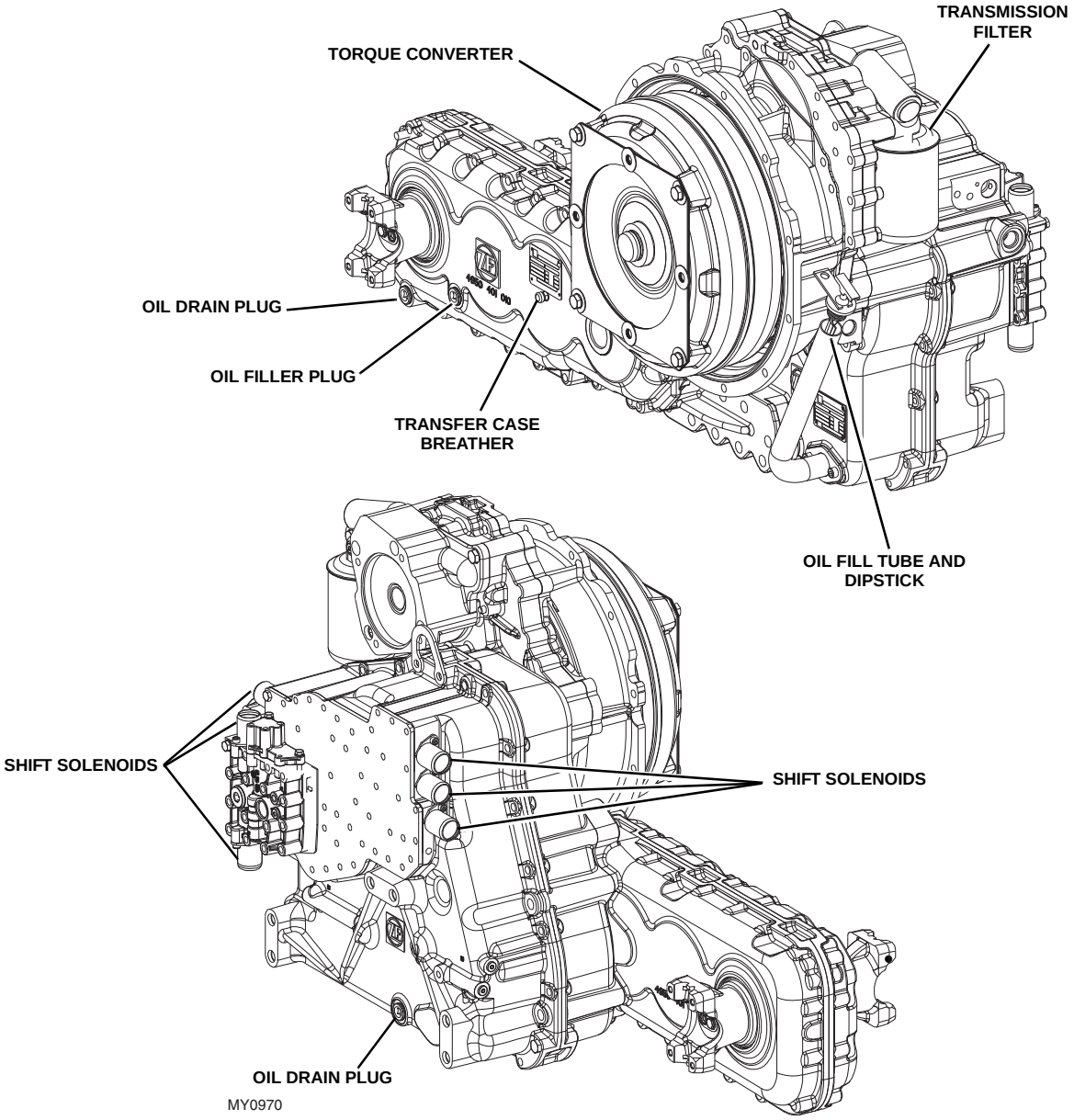
Section 6
Transmission

Contents

PARAGRAPH	TITLE	PAGE
6.1	**Transmission Assembly Component Terminology**	**6-2**
6.2	**Transmission Serial Number**	**6-3**
6.3	**Transmission Specifications And Maintenance Information**	**6-3**
6.4	**Transmission Replacement**	**6-3**
6.4.1	Transmission Removal	6-3
6.4.2	Transmission Inspection and Internal Repair	6-4
6.4.3	Transmission Installation	6-5
6.4.4	After Transmission Service or Replacement	6-5
6.5	**Torque Convertor Diaphragm**	**6-6**
6.5.1	Torque Convertor Diaphragm Removal	6-6
6.5.2	Torque Convertor Diaphragm Installation	6-6
6.6	**Troubleshooting**	**6-7**

6.1 TRANSMISSION ASSEMBLY COMPONENT TERMINOLOGY

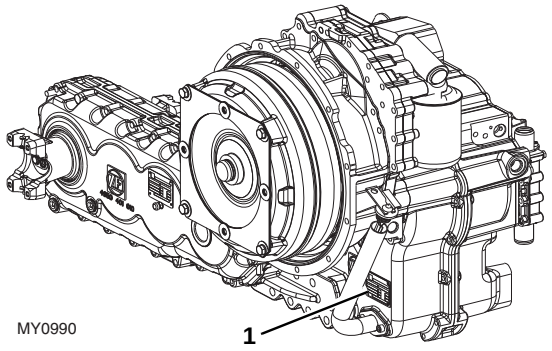
To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the transmission. The following illustration identifies the components that are referred to throughout this section.



WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual.

6.2 TRANSMISSION SERIAL NUMBER



The transmission serial number plate (**1**) is located on the front of the transmission case behind the oil dipstick. Information on the serial number plate is required in correspondence regarding the transmission.

6.3 TRANSMISSION SPECIFICATIONS AND MAINTENANCE INFORMATION

For transmission, oil specifications and maintenance information, refer to Section 2, “General Information and Specifications.”

Detailed transmission service instructions are provided in the following publications:

- Service Manual (P/N 31200241)
- Parts Manual (P/N 31200257)

6.4 TRANSMISSION REPLACEMENT

Note: *Contact the local distributor if internal transmission repair is required during the warranty period.*

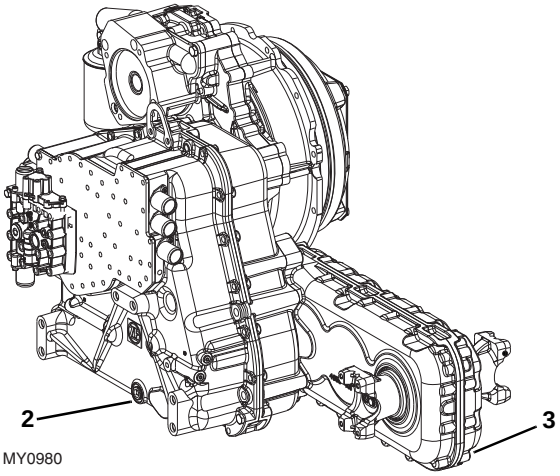
Note: *Cleanliness is of extreme importance. Before attempting to remove the transmission, thoroughly clean the exterior of the transmission to help prevent dirt from entering during the replacement process. Avoid spraying water or cleaning solution onto or near the transmission shift solenoids and other electrical components.*

6.4.1 Transmission Removal

WARNING

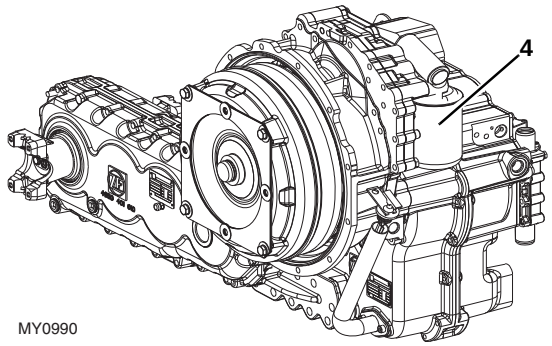
NEVER lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling with a minimum lifting capacity of 1000 lb (454 kg).

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove engine cover to allow easier access to the transmission.
5. Drain the hydraulic oil reservoir. Refer to Section 8.5.1, “Hydraulic Oil Reservoir Draining.”
6. Properly disconnect the battery.
7. Thoroughly clean the transmission and surrounding area, including all hoses and fittings, before proceeding.



8. Place a suitable receptacle under the transmission drain plug (**2**). Remove the transmission drain plug, and allow the transmission oil to drain into the receptacle. Repeat drain procedure with the drop box (**3**).

9. Transfer the used transmission oil into a suitable, covered container, and label the container as “Used Oil.” Dispose of used oil at an approved recycling facility. Clean and reinstall the transmission drain plug.
10. Remove the transmission-to-axle drive shafts. Refer to Section 5.4.3, “Drive Shaft Removal.”
11. Remove air cleaner unit and intake tubes.
12. Remove the hydraulic pump. Refer to Section 8.6.1, “Implement Pump Replacement.”
13. Label and disconnect the transmission temperature switch connector and shift solenoid wiring harness connectors.
14. Label, disconnect and cap the transmission oil cooler inlet and outlet hoses at the transmission.
15. Remove the access plug from side of the engine bell housing. This will allow access to remove the four bolts holding the torque convertor diaphragm to the engine flywheel.
16. Turn the engine over slowly by hand and align each of the four torque convertor diaphragm bolts to be accessed. Remove them one at a time.
17. Wipe up any spilled hydraulic and transmission oil.
18. Connect a lifting strap or chain to the lifting eye at the top of the transmission, and to a suitable hoist or overhead crane. Operate the hoist or crane to remove slack from the chain, but **DO NOT** raise the transmission at this time.
19. Place blocks under rear of engine for support BEFORE transmission mounts are removed.
20. Place blocks under the transmission to help support it during removal.
21. Remove both rear transmission mount bolts and lockwashers securing the transmission mount to the frame.
22. Remove the bolts and washers holding the transmission to the engine.
23. Remove the capscrews and lockwashers securing each rear transmission mount to the transmission.
24. Carefully remove the transmission from the machine. Avoid causing damage to the transmission or surrounding parts.
25. Lift the transmission clear of the machine, and lower it onto suitable supports or secure it to a stand built especially for transmission or engine service. Secure the transmission so that it will not move or fall.
26. Remove any external transmission components as required, including the transmission temperature switch, and inlet and outlet cooler hose fittings. Cover all transmission openings.



27. Remove the transmission oil filter (**4**) and dispose of properly. Clean the filter mounting surface. Cover or cap the oil filter mount.
28. If transmission oil is suspect to contamination or torque converter is damaged, remove the converter and flex plate from the transmission.
29. Remove the bolt and washers holding the converter to the flex plate.

6.4.2 Transmission Inspection and Internal Repair

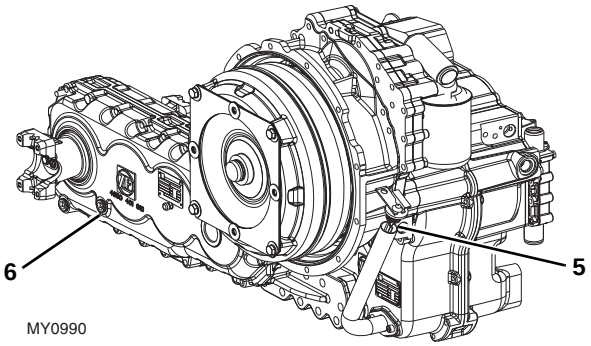
If replacing the entire transmission, transfer the transmission temperature switch to the replacement transmission. The gear shift solenoids are included with a new transmission.

6.4.3 Transmission Installation

WARNING

NEVER lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling.

1. Install both rear transmission mounts on the transmission. Torque capscrews to 125-140 lb-ft (170-190 Nm).
2. Install two guide studs near the top of the bell housing holes.
3. Use a hoist or overhead crane and sling attached to the lifting eye at the top of the transmission. Raise and position the transmission within the chassis.
4. Align the torque converter, align the transmission bolt holes with the two studs in the bell housing. Install the eight bolts and washers and torque to 53 lb-ft (72 Nm). Remove the two alignment studs and install and torque the last two transmission mounting bolts.
5. Install the two rear transmission mounting bolts on the frame with two capscrews and two lockwashers. Apply Loctite® 242 to the transmission mount bolts and torque to 125-140 lb-ft (169-190 Nm)
6. Turn the engine over slowly by hand and align each of the four torque convertor diaphragm bolts through the access plug in the bell housing. Install them one at a time. DO NOT fully tighten until all of the capscrews and locknuts are in place. Torque to 26-39 lb-ft (35-59 Nm). Replace access plug.
7. Remove the hoist or overhead crane and sling.
8. Connect the transmission temperature switch connector and shift solenoid wiring harness connectors.
9. Secure the wiring harness to the transmission housing.
10. Connect the transmission oil cooler inlet and outlet hoses at the transmission.
11. Install the hydraulic pump. Refer to Section 8.6.1, “Implement Pump Replacement.”
12. Install the transmission-to-axle drive shafts. Refer to Section 5.4.5, “Drive Shaft Installation.”
13. Install the air cleaner and tubing.
14. Clean the transmission oil filter mounting surface.
15. Apply a thin film of clean hydraulic oil to the new transmission filter gasket. Install the new filter and torque to 20-25 lb-ft (27-34 Nm).



16. Transmission oil may be added through the dipstick tube (**5**). Remove the dipstick and add hydraulic oil. Check the oil level by taking intermittent dipstick readings as outlined in the appropriate Operation & Safety Manual. **DO NOT** overfill. Reinstall the dipstick when finished.
17. Transmission transfer case fluid may be added through the fill plug (**6**). Remove the fill plug and add approximately 1.5 quarts (1,4 liters) of hydraulic oil. Install fill plug and tighten.
18. Properly connect the battery.
19. Install the engine cover.
20. Close and secure the engine cover.
21. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

6.4.4 After Transmission Service or Replacement

In general:

1. Check the transmission oil level and add oil as required.
2. Disconnect and clean all transmission cooler hoses. When possible, remove transmission lines from the machine for cleaning.
3. Drain and flush the entire transmission cooling system.
4. Thoroughly clean transmission filter screens and cases, and replace transmission filter elements.
5. Reassemble all components and fill the transmission with clean, fresh hydraulic oil through the dipstick tube opening (**5**). Check the level by taking intermittent dipstick readings as outlined in the appropriate Operation & Safety Manual. **DO NOT** overfill. Reinstall the dipstick when finished.

6. Transmission transfer case fluid may be added through the fill plug (**6**). Remove the fill plug and add approximately 1.5 quarts (1,4 liters) of hydraulic oil. Install fill plug and tighten.
7. Run the engine for two minutes at idle to help prime the torque converter and the transmission oil lines.
8. Recheck the level of the fluid in the transmission with the engine running at idle.
9. Add hydraulic oil as necessary to bring the fluid level up until it reaches the FULL mark on the dipstick. Recheck the oil level when it reaches operating temperature 180-200° F (83-94° C).
10. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary.

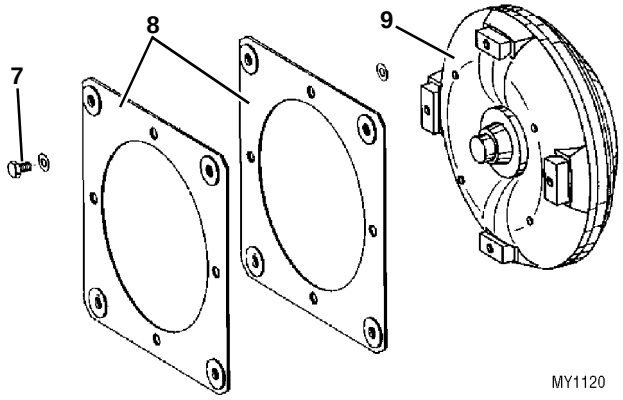
6.5 TORQUE CONVERTOR DIAPHRAGM

6.5.1 Torque Convertor Diaphragm Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.

Note: *In order to remove the engine drive plates, the engine and transmission must be separated.*

2. Refer to Section 6.4.1, “Transmission Removal,” or Section 7.9.1, “Engine Removal.”



3. Remove the four bolts holding the diaphragms to the flywheel.
4. With the drive plates and torque converter removed, loosen and remove the four bolts (**7**) and eight lock washers holding the two diaphragms (**8**) to the torque converter (**9**).
5. Replace both diaphragms if damaged.

6.5.2 Torque Convertor Diaphragm Installation

1. Install the two new diaphragms on the torque converter and install the four bolts with lock washers.
2. Mount the diaphragm/converter assembly to the transmission.
3. Refer to Section 6.4.3, “Transmission Installation,” or Section 7.9.2, “Engine Installation,” for the remainder of the installation.

6.6 TROUBLESHOOTING

This section provides an easy reference guide covering the most common problems that may occur during operation of the transmission.

Note: *Contact the local distributor if internal transmission repair is required during the warranty period.*

The transmission should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features

Problem	Cause	Remedy
1. Transmission will not engage or will not shift properly.	1. Oil level too high or low.	1. Fill transmission to correct level with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	2. Transmission control lever not functioning properly and/or a fault in the wiring harness.Transmission control lever not functioning properly and/or a fault in the wiring harness.	2. Refer to Section 9.5, “Electrical System Schematics.”
	3. Transmission valve body solenoids not functioning properly.	3. Refer to Section 9.5, “Electrical System Schematics.”
	4. Pilot-operated shift valves not operating properly.	4. Clean the valve spool and housing. Replace return spring as needed.
	5. Pump output pressure low.	5. Refer to Section Note:, “Contact the local distributor if internal transmission repair is required during the warranty period.,” **Problem 2.** “Low or no pump flow or pressure.”
	6. Clutch piston o-rings damaged.	6. Replace o-rings.
	7. Clutch discs worn or damaged.	7. Replace clutch discs.
	8. Coupling shafts or gear teeth damaged.	8. Replace couplings.

Problem	Cause	Remedy
2. Low or no pump flow or pressure.	1. Low oil level.	1. Fill transmission to correct level with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	2. Transmission filled with incorrect oil, or oil contaminated.	2. Drain transmission and fill to correct level with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	3. Pump suction pipe screen clogged.	3. Clean, repair and/or replace suction pipe.
	4. Central shaft damaged.	4. Replace central shaft.
	5. Pump worn or damaged.	5. Repair or replace pump assembly.
3. Low clutch pressure.	1. Incorrect oil level.	1. Fill transmission to correct level with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	2. Main pressure valve stuck open.	2. Clean the valve spool and housing.
	3. Broken or worn coupling shaft or piston o-rings.	3. Replace coupling and/or o-rings.
	4. Pressure reducing valve stuck open.	4. Clean the valve spool and housing.
4. Lack of power.	1. Park or service brake dragging.	1. Refer to Section 8.4, “Hydraulic Circuits.”
	2. Low engine rpm causes converter stall.	2. Adjust the engine rpm to specifications. Refer to Engine Service Manual.
	3. Pump output pressure is low.	3. Refer to Section Note:, “Contact the local distributor if internal transmission repair is required during the warranty period.,” **Problem 2.** “Low or no pump flow or pressure.”
	4. Clutch discs worn or damaged.	4. Replace clutch discs.
	5. Transmission overheating.	5. Refer to Section Note:, “Contact the local distributor if internal transmission repair is required during the warranty period.,” **Problem 5.** “Transmission overheating (oil above 248° F (120° C)).”

Problem	Cause	Remedy
5. Transmission overheating (oil above 248° F (120° C)).	1. Low oil level.	1. Fill transmission to correct level with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	2. Clogged radiator.	2. Remove debris from the radiator.
	3. Transmission filled with incorrect oil, or oil contaminated.	3. Drain transmission and fill to correct level with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	4. Excessive “roading.”	4. Stop and idle the engine.
	5. Restriction in oil cooler hoses.	5. Replace cooler hoses.
	6. Pump worn or damaged.	6. Repair or replace pump assembly.
	7. Engine thermostat stuck.	7. Replace engine thermostat. Refer to Section 7.4.2, “Thermostat Replacement.”
6. Grinding or “clunking” noise from transmission.	1. Oil level too low.	1. Fill oil to correct level. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
		2. Repair or replace parts as needed.
	2. Transmission filled with incorrect oil.	3. Drain transmission and fill to correct level with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
	3. Incorrect clutch engagement.	4. Refer to Section 9.10.3, “Transmission Solenoid Valves.”
	4. Internal damage.	5. Repair or replace parts as needed.
	5. Broken diaphragm (torque convertor).	6. Replace diaphragm (torque convertor). Refer to Section 6.4.1, “Transmission Removal.”
	6. Loose diaphragm (torque convertor) mounting capscrews.	7. Tighten capscrews.

Problem	Cause	Remedy
7. Oil leaking from transmission.	1. Oil leaking from vent (high oil level).	1. Remove drain plug and drain oil as needed, until oil is at correct level. Refer to Section 2.4, “Fluid and Lubricant Capacities.” Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. Drain plug loose and/or o-rings damaged or missing.	2. Replace o-rings as needed and tighten plug to 26 lb-ft (35 Nm).
	3. Hose fittings loose.	3. Tighten fittings.
	4. Oil leaking at valve bodies (possible valve body gaskets damaged or missing and/or mounting capscrews not tight).	4. Replace gaskets and/or tighten capscrews to 7 lb-ft (9,5 Nm).
	5. Housing capscrews loose.	5. Tighten capscrews to 34 lb-ft (46 Nm).
	6. Oil leaking at pump (possible pump-to-housing o-rings missing or damaged, and/or pump mounting capscrews not tight).	6. Replace o-rings and/or tighten capscrews to 85 lb-ft (115 Nm).
	7. Oil leaking at converter bell (possible converter leak and/or input shaft seal damage).	7. Replace converter and/or input shaft seal.
	8. Oil leaking at output shaft (output shaft seal damaged).	8. Replace output shaft seal.
	9. Oil escaping from breather at shut down.	9. Transmission may be under full. Ensure transmission is at operating temperature, 185° F (85° C) and fill to upper mark on transmission dip stick.
	10. Housing damaged.	10. Replace housing as needed.

Section 7
Engine

Contents

PARAGRAPH		TITLE	PAGE
7.1		**Introduction - John Deere**	**7-2**
	7.1.1	Disclaimer and Scope	7-2
	7.1.2	Engine Serial Number	7-2
	7.1.3	Specifications and Maintenance Information	7-2
	7.1.4	Component Terminology	7-3
7.2		**Introduction - Perkins**	**7-4**
	7.2.1	Disclaimer and Scope	7-4
	7.2.2	Engine Serial Number	7-4
	7.2.3	Specifications and Maintenance Information	7-4
	7.2.4	Component Terminology	7-5
7.3		**Introduction - Cummins**	**7-6**
	7.3.1	Disclaimer and Scope	7-6
	7.3.2	Engine Serial Number	7-6
	7.3.3	Specifications and Maintenance Information	7-6
	7.3.4	Component Terminology	7-7
7.4		**Engine Cooling System**	**7-8**
	7.4.1	Radiator Pressure Cap	7-8
	7.4.2	Thermostat Replacement	7-8
	7.4.3	Radiator/Oil Cooler and Replacement	7-9
7.5		**Engine Electrical System**	**7-10**
7.6		**Fuel System**	**7-10**
	7.6.1	Diesel Fuel	7-10
	7.6.2	Fuel Tank	7-10
	7.6.3	After Fuel System Service	7-12
7.7		**Engine Exhaust System**	**7-12**
	7.7.1	Exhaust System Removal	7-12
	7.7.2	Exhaust System Installation	7-13
7.8		**Air Cleaner Assembly**	**7-13**
	7.8.1	Air Cleaner Assembly Removal (John Deere & Perkins)	7-13
	7.8.2	Air Cleaner Assembly Installation (John Deere & Perkins)	7-13
	7.8.3	Air Cleaner Assembly Removal (Cummins)	7-13
	7.8.4	Air Cleaner Assembly Installation (Cummins)	7-14
7.9		**Engine Replacement**	**7-14**
	7.9.1	Engine Removal	7-14
	7.9.2	Engine Installation	7-15
7.10		**Troubleshooting**	**7-17**

7.1 INTRODUCTION - JOHN DEERE

7.1.1 Disclaimer and Scope

These instructions are written for worldwide use. In territories where legal requirements govern engine smoke emission, noise, safety factors, etc., apply all instructions, data and dimensions provided herein in such a way that after maintenance, service and repair of the engine, engine operation does not violate local regulations.

Note: *These instructions cover only the routine maintenance, removal, installation and troubleshooting of the engine. Refer to the local Engine Distributor and the applicable Engine Service Manual for assistance with comprehensive engine diagnosis, repair and component replacement. A gradual running-in (break-in) of a new engine is not necessary. Full load can be applied to a new engine as soon as the engine is put into service and the coolant temperature is at least 140° F (60° C). Extended light-load operation during the early life of the engine is not recommended.* ***DO NOT*** *run the engine at high, no-load speeds.* ***DO NOT*** *apply an overload to the engine.*

7.1.2 Engine Serial Number

The John Deere 4045HF275 serial number Is stamped on a plate which is secured to the engine block, near the fuel injector pump. Information contained in the serial number is required in correspondence with the engine manufacturer.

7.1.3 Specifications and Maintenance Information

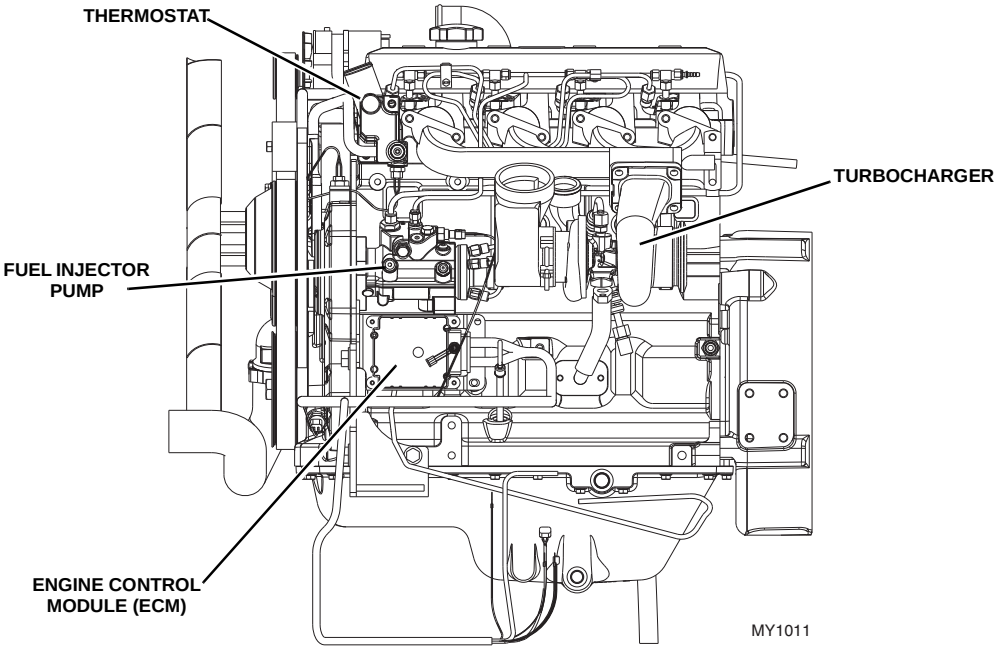
For engine, coolant and oil specifications, and maintenance information, refer to Section 2, “General Information and Specifications.”

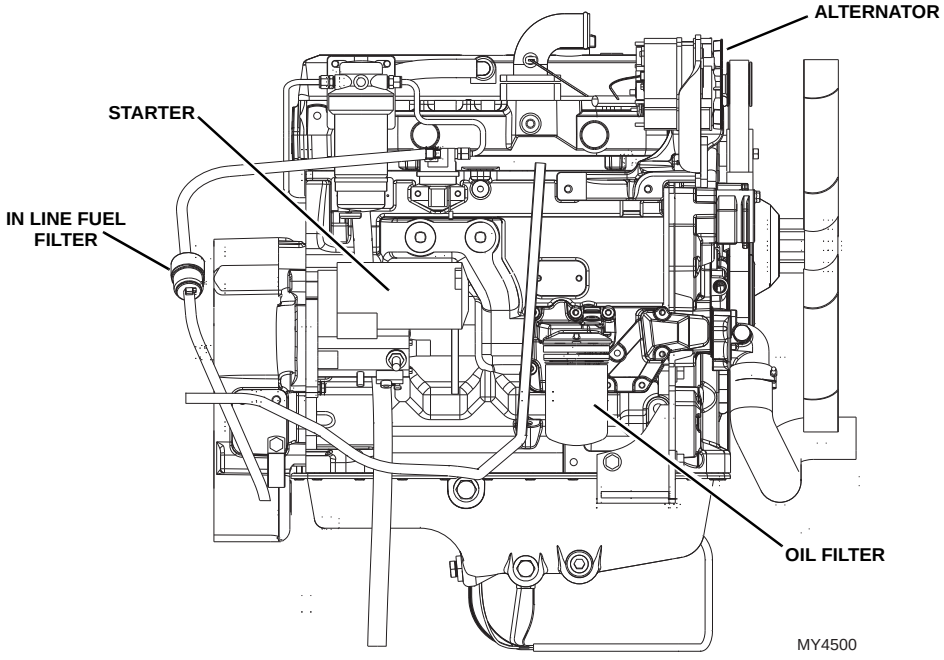
Detailed John Deere engine service instructions (covering disassembly, inspection, internal repair, assembly, adjustment and troubleshooting information) are provided in the appropriate John Deere engine service manual.

For engine electrical related issues, refer to the John Deere Engine Troubleshooting Manual (P/N 31200371).

7.1.4 Component Terminology

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the engine components. The following illustration identifies the components that are referred to throughout this section.





7.2 INTRODUCTION - PERKINS

7.2.1 Disclaimer and Scope

These instructions are written for worldwide use. In territories where legal requirements govern engine smoke emission, noise, safety factors, etc., apply all instructions, data and dimensions provided herein in such a way that after maintenance, service and repair of the engine, engine operation does not violate local regulations.

Note: *These instructions cover only the routine maintenance, removal, installation and troubleshooting of the engine. Refer to the local Engine Distributor and the applicable Engine Service Manual for assistance with comprehensive engine diagnosis, repair and component replacement. A gradual running-in (break-in) of a new engine is not necessary. Full load can be applied to a new engine as soon as the engine is put into service and the coolant temperature is at least 140° F (60° C). Extended light-load operation during the early life of the engine is not recommended.* ***DO NOT*** *run the engine at high, no-load speeds.* ***DO NOT*** *apply an overload to the engine.*

7.2.2 Engine Serial Number

The Perkins 1104D serial number Is stamped on top of the engine. Information contained in the serial number is required in correspondence with the engine manufacturer.

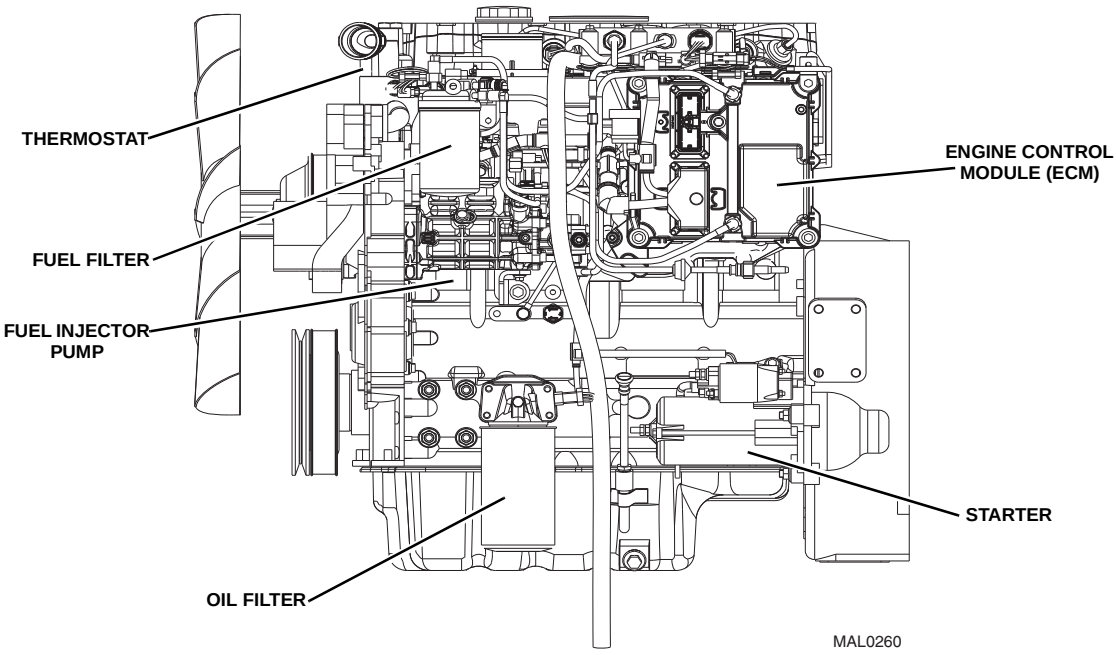
7.2.3 Specifications and Maintenance Information

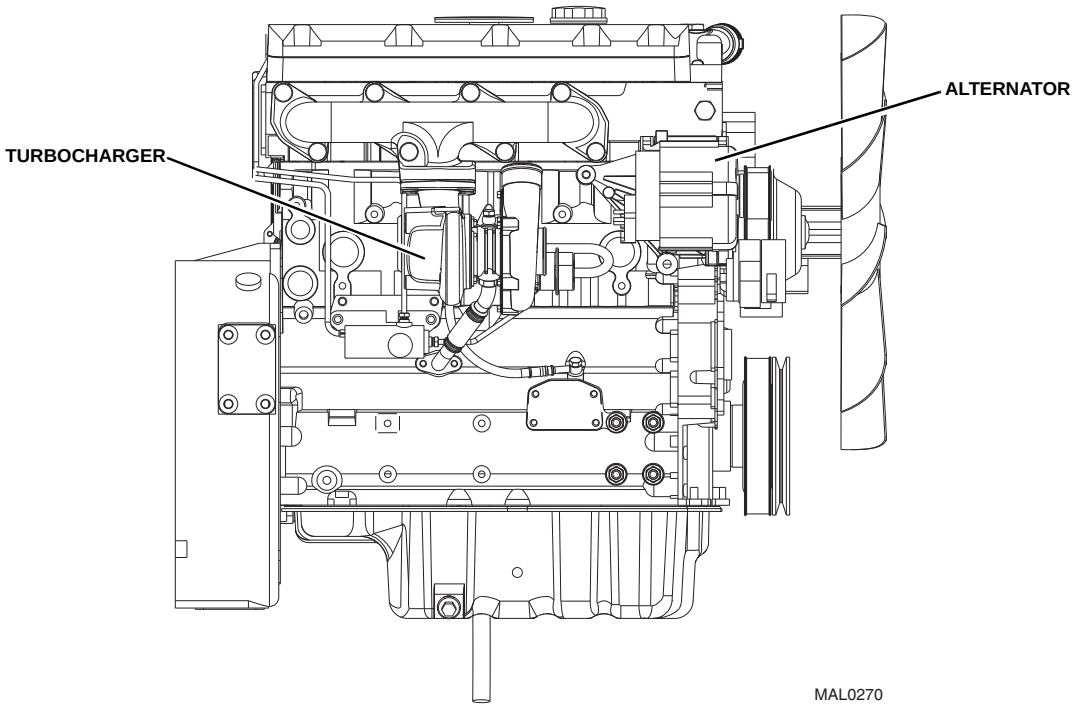
For engine, coolant and oil specifications, and maintenance information, refer to Section 2, “General Information and Specifications.”

Detailed Perkins engine service instructions (covering disassembly, inspection, internal repair, assembly, adjustment and troubleshooting information) are provided in the appropriate Perkins engine service manual.

7.2.4 Component Terminology

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the engine components. The following illustration identifies the components that are referred to throughout this section.





7.3 INTRODUCTION - CUMMINS

7.3.1 Disclaimer and Scope

These instructions are written for worldwide use. In territories where legal requirements govern engine smoke emission, noise, safety factors, etc., apply all instructions, data and dimensions provided herein in such a way that after maintenance, service and repair of the engine, engine operation does not violate local regulations.

Note: *These instructions cover only the routine maintenance, removal, installation and troubleshooting of the engine. Refer to the local Engine Distributor and the applicable Engine Service Manual for assistance with comprehensive engine diagnosis, repair and component replacement. A gradual running-in (break-in) of a new engine is not necessary. Full load can be applied to a new engine as soon as the engine is put into service and the coolant temperature is at least 140° F (60° C). Extended light-load operation during the early life of the engine is not recommended.* ***DO NOT*** *run the engine at high, no-load speeds.* ***DO NOT*** *apply an overload to the engine.*

7.3.2 Engine Serial Number

The Cummins serial number Is stamped on top of the engine. Information contained in the serial number is required in correspondence with the engine manufacturer.

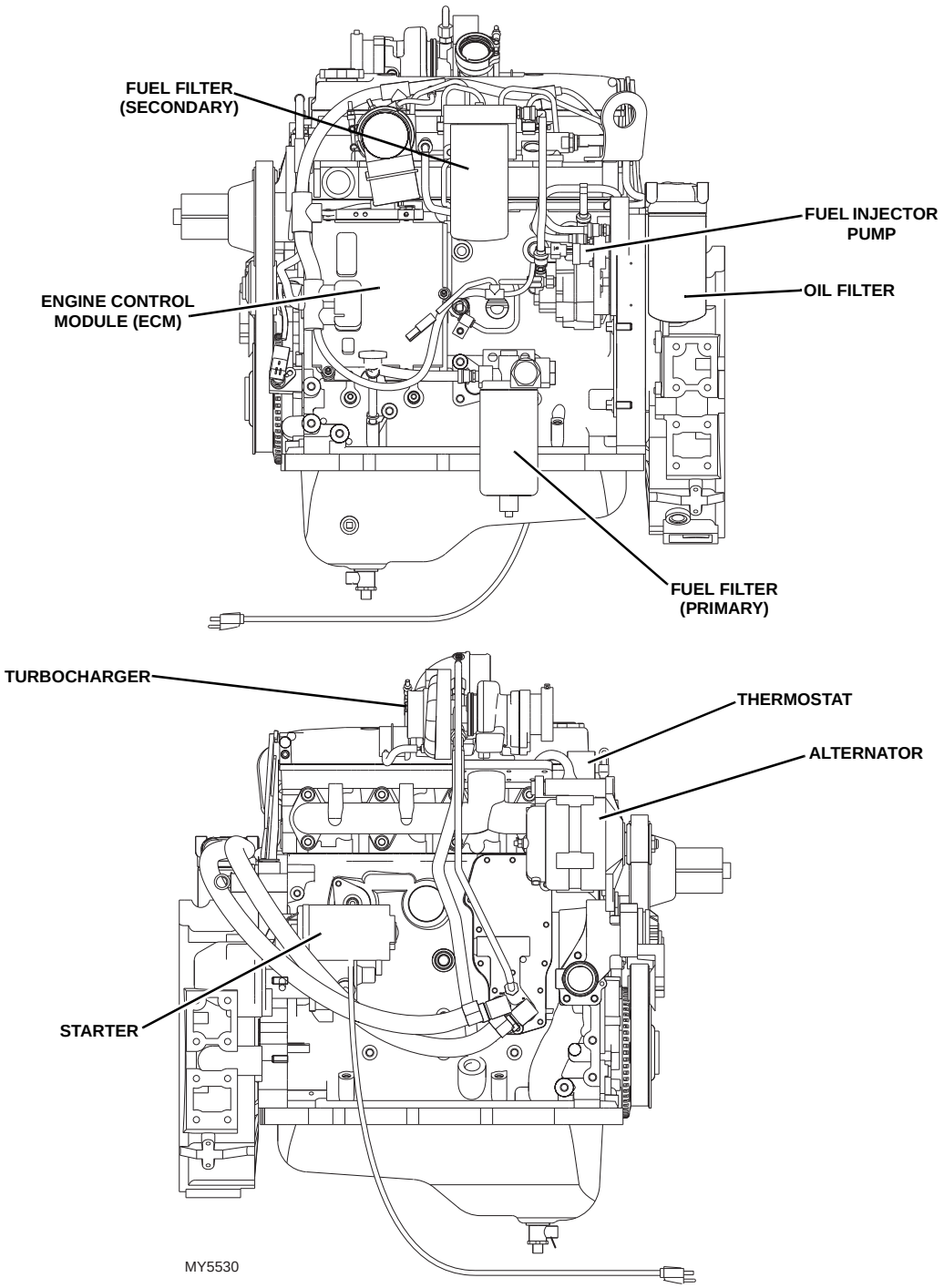
7.3.3 Specifications and Maintenance Information

For engine, coolant and oil specifications, and maintenance information, refer to Section 2, “General Information and Specifications.”

Detailed Cummins engine service instructions (covering disassembly, inspection, internal repair, assembly, adjustment and troubleshooting information) are provided in the appropriate Cummins engine service manual.

7.3.4 Component Terminology

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the engine components. The following illustration identifies the components that are referred to throughout this section.



7.4 ENGINE COOLING SYSTEM

7.4.1 Radiator Pressure Cap

John Deere/Perkins: For a 210° F (99° C) system, use a 13 psi (90 kPa) radiator cap. An incorrect or malfunctioning cap can result in the loss of coolant and a hot-running engine.

Cummins: For a 210° F (99° C) system, use a 16 psi (110 kPa) radiator cap. An incorrect or malfunctioning cap can result in the loss of coolant and a hot-running engine.

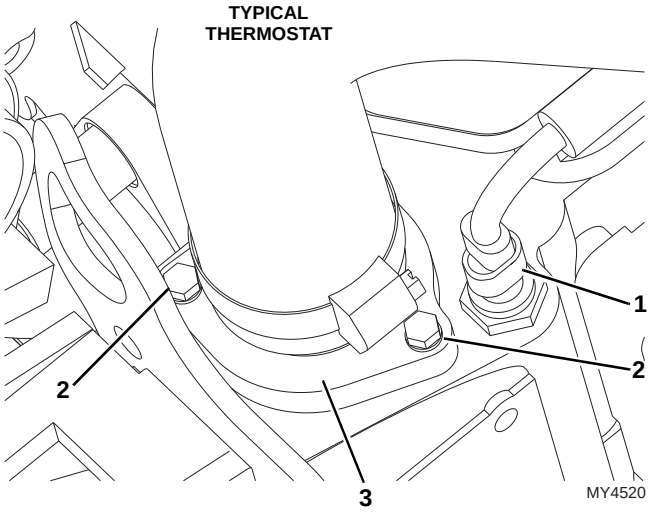
7.4.2 Thermostat Replacement

Before considering thermostat replacement, check the coolant level, fan belt tension and instrument cluster temperature indicator.

- If the engine seems to take a long time to warm up, the thermostat may be stuck in the open position and requires replacement.
- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

a. Thermostat Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Slowly turn the radiator cap to the first stop and allow any pressure to escape. Remove the radiator cap.
6. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain plug and slowly remove to allow the coolant to drain. Transfer the coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Replace the radiator drain plug.



7. Disconnect the engine water temperature sender (**1**) if connected to the thermostat housing.
8. Remove the two capscrews (**2**) securing the thermostat housing (**3**) to the engine.
9. Remove the thermostat housing, old gasket and thermostat. Clean all gasket surfaces. **DO NOT** let any debris into the thermostat opening.

Note: *ALWAYS use the correct thermostat and install a new gasket.* ***NEVER*** *operate the engine without a thermostat, or engine damage will result.*

b. Thermostat Installation

1. Install the engine thermostat, thermostat gasket and thermostat housing. Secure with the two capscrews and torque as required.
2. Connect the engine water temperature sender if connected to the thermostat housing.
3. Properly connect the battery.
4. Open the radiator cap, and fill the radiator completely with coolant. Replace and tighten the radiator cap. Add coolant to the overflow bottle until the bottle is 1/4 to 1/2 full. This overfilling will compensate for any air trapped in the cooling system.
5. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle and fill, or drain, as necessary.
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

7.4.3 Radiator/Oil Cooler and Replacement

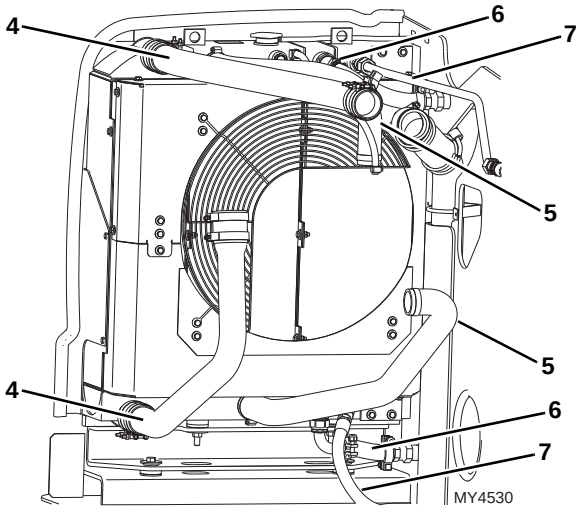
Before considering radiator or oil cooler replacement for other than obvious damage, conduct a cooling system pressure test check the coolant specific gravity, coolant level, fan belt tension and dash panel temperature indicator.

- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

a. Radiator/Oil Cooler Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Slowly turn the radiator cap to the first stop and allow any pressure to escape. Remove the radiator cap.
6. Place a suitable container beneath the radiator drain.
7. Place a funnel at the base of the radiator to channel the drained coolant into a container. Loosen the drain cock and slowly remove to allow the coolant to drain. Transfer the coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Tighten the radiator drain cock.
8. Label, disconnect and cap the hoses attached to the coolant recovery tank. Remove the coolant recovery tank.

CUMMINS RADIATOR ASSSEMBLY



9. Loosen the clamps on the hoses/tubes (**4**) attached to the intercooler. Work the hoses off the intercooler. Position the hoses out of the way to allow radiator removal, or remove the hoses from the engine. Inspect the hoses, and replace if necessary.
10. Loosen the clamps on the hoses (**5**) attached to the radiator. Work the hoses off the radiator. Position the hoses out of the way to allow radiator removal, or remove the hoses/tubes from the engine. Inspect the hoses, and replace if necessary.
11. Loosen and remove the hoses (**6**) attached to the oil cooler. Plug and/or cap the hoses to prevent dirt and debris from entering the hydraulic system. Position the hoses out of the way to allow radiator removal, or remove the hoses from the engine. Inspect the hoses, and replace if necessary.

12. Loosen and remove the hoses (**7**) attached to the transmission cooler. Plug and/or cap the hoses to prevent dirt and debris from entering the transmission system. Position the hoses out of the way to allow radiator removal, or remove the hoses from the engine. Inspect the hoses, and replace if necessary.
13. Remove the radiator fan guard.
14. Remove the nuts and washers the radiator fan shroud and pull the shroud back over the fan.
15. Remove the nuts and washers from the radiator and oil cooler mounts.
16. Carefully lift the radiator and oil cooler out of the engine compartment.

Note: *If more clearance is needed to remove the radiator, the engine fan may be removed for easier access.*

b. Radiator/Oil Cooler Installation

1. Install the isolator mounts to the bottom of the radiator and oil cooler. Place the radiator and oil cooler in the engine compartment at their original orientations. Secure with the previously used hardware.

Note: *Be sure there is adequate clearance between the radiator and the engine fan.*

2. If necessary, install the engine fan.
3. Install the radiator fan shroud.
4. Uncap and connect the previously labeled hoses to the radiator, oil cooler and/or transmission cooler.
5. Connect both intercooler hoses.
6. Install the coolant recovery tank. Uncap and connect the previously removed hose.
7. Open the radiator cap and fill the radiator completely with coolant. Replace and tighten the radiator cap. Refer to Section 2.4, “Fluid and Lubricant Capacities,” for proper capacities.
8. Properly connect the battery.
9. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle and fill, or drain, as necessary.
10. Close and secure the engine cover.
11. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

7.5 ENGINE ELECTRICAL SYSTEM

The engine electrical system, including the starter, alternator and primary wiring, is described in Section 9.5, “Electrical System Schematics.”

7.6 FUEL SYSTEM

7.6.1 Diesel Fuel

Fuel represents a major portion of machine operating costs and therefore must be used efficiently. ALWAYS use a premium brand of high-quality, clean diesel fuel. Low cost, inferior fuel can lead to poor performance and expensive engine repair.

Note: *Use only diesel fuel designed for diesel engines. Some heating fuels contain harmful chemicals that can seriously affect engine efficiency and performance.*

Note: *Due to the precise tolerances of diesel injection systems, keep the fuel clean, and free of dirt and water. Dirt and water in the fuel system can cause severe damage to both the injection pump and the injection nozzles. Use ASTM #2 diesel fuel with a minimum Cetane rating of 40. #2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to help prevent misfiring and excessive smoking.*

Inform the owner/operator of the machine to use #2 diesel fuel, unless ambient temperatures are below 32° F (0° C). When temperatures are below 32° F (0° C), a blend of #1 diesel and #2 diesel fuels (known as “winterized” #2 diesel) may be used.

Note: *#1 diesel fuel may be used, however, fuel economy will be reduced.*

Use a low-sulfur content fuel with a cloud point (the temperature at which wax crystals form in diesel fuel) at least 10° below the lowest expected fuel temperature. The viscosity of the fuel must be kept above 1.3 centistrokes to provide adequate fuel system lubrication.

7.6.2 Fuel Tank

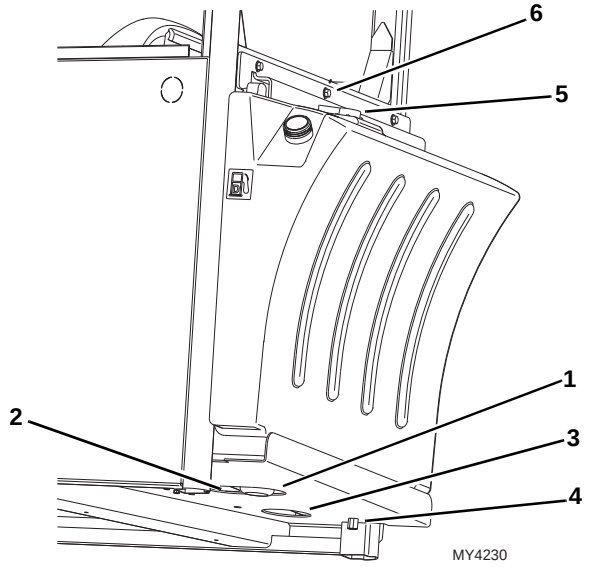
Note: *The fuel tank is a one piece unit. It is located on the rear of the cab. If it is determined that the fuel tank must be removed, the fuel must be drained before tank removal. Always dispose of fuel properly.*

a. Fuel Tank Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.

Note: *If replacing the tank, remove all internal and external components from the old tank, and retain for use on the replacement tank.*

Note: *Have a dry chemical (Class B) fire extinguisher near the work area.*



5. Remove fuel tank drain plug (**1**), and drain fuel into an approved and suitable container. Dispose of fuel properly.
6. Label, disconnect and cap the supply fuel line (**2**) from the bottom of the fuel tank.
7. Label, disconnect and cap the return fuel line (**3**) from the bottom of the fuel tank.
8. Disconnect the fuel gauge harness (**4**).
9. Remove screws securing fuel sender (**5**) to the tank. Remove fuel sender from tank.
10. Remove the bolts on the fuel tank hold down bar (**13**).
11. Lift the empty fuel tank from the rear of the cab.

b. Disassembly

The fuel tank is a one-piece unit and cannot be disassembled. The fuel level indicator can be removed and reused on the new replacement tank. Dispose of the old tank according to local regulations concerning hazardous materials disposal.

c. Cleaning and Drying

If contaminated fuel or foreign material is in the tank, the tank can usually be cleaned.

Note: *If a leak is suspected in the fuel tank, contact **JLG** Service Department.*

To clean the fuel tank:

1. Have a dry chemical (Class B) fire extinguisher near the work area.
2. Remove the fuel or oil tank drain plug, and safely drain any fuel into a suitable container. Dispose of fuel properly.
3. Clean the fuel tank with a high-pressure washer, or flush the tank with hot water for five minutes and drain the water. Dispose of contaminated water properly.
4. Add a diesel fuel emulsifying agent to the tank. Refer to the manufacturer's instructions for the correct emulsifying agent-to-water mixture ratio. Refill the tank with water, and agitate the mixture for 10 minutes. Drain the tank completely. Dispose of contaminated water properly.
5. Refill the fuel tank with water until it overflows. Completely flush the tank with water. Empty the fuel tank, and allow it to dry completely.

d. Assembly

The fuel level indicator can be removed and reused on the new replacement tank. Dispose of the old tank according to local regulations concerning hazardous materials disposal regulations.

e. Inspection

Note: *If a leak is suspected in the fuel tank, contact a **JLG** Service Department.*

1. Inspect the fuel tank thoroughly for any cracks, slices, leaks or other damage.
2. With the fuel tank removed from the machine, plug all openings except one elbow fitting. Install the elbow fitting, and apply approximately 1-1.5 psi (7-10 kPa) of air pressure through the elbow. Check the reservoir for leaks by applying a soap solution to

the exterior and look for bubbles to appear at the cracked or damaged area.

f. Fuel Tank Installation

1. Set fuel tank in its original orientation at the rear of the cab.
2. Install the fuel tank hold down bar.
3. Install the fuel sender with new gasket into the fuel tank and secure with screws. **DO NOT** overtighten.
4. Connect the previously labeled fuel hoses to their appropriate locations. Secure with clamps.
5. Connect the fuel gauge harness.
6. Fill the fuel tank according to specifications.Refer to Section 2.4, “Fluid and Lubricant Capacities.”
7. Check fuel tank for leaks.
8. Properly connect the battery.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

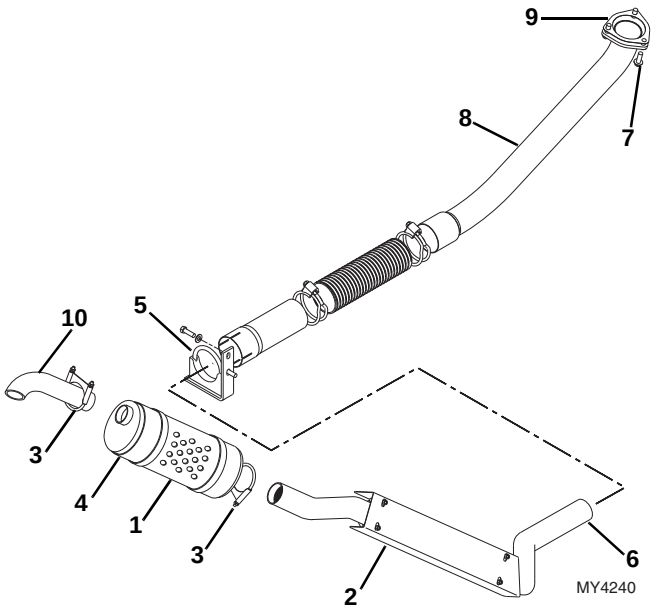
7.6.3 After Fuel System Service

1. Drain and flush the fuel tank if it was contaminated.
2. Vent air from the fuel system in accordance with the instructions found in the appropriate Operation & Safety Manual.
3. Fill the fuel tank with fresh, clean diesel fuel as required.

7.7 ENGINE EXHAUST SYSTEM

7.7.1 Exhaust System Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids and the exhaust system to cool.
4. Properly disconnect the battery.



5. Remove the muffler heat shield (**1**)
6. Remove the exhaust heat shield (**2**).
7. Loosen and remove both clamps (**3**) securing the muffler (**4**) to the frame mounted brackets. Remove the muffler.
8. Loosen and remove the clamp (**5**) securing the exhaust pipe (**6**) to the frame at the bottom rear corner of the engine pod. Remove the exhaust pipe.

Note: *Removal of the turbo charger heat shields may be required to access exhaust pipe bolts.*

9. Disconnect and remove the three bolts (**7**) securing the exhaust pipe/flex pipe (**8**) to the turbo charger. Remove the exhaust pipe/flex pipe from under machine.

7.7.2 Exhaust System Installation

Note: *Keep all clamps loosened until entire exhaust system is in place.*

1. Install the exhaust pipe/flex pipe (**8**) with a new seal (**9**) to the turbo charger.
2. Install the exhaust pipe/flex pipe clamp (**5**) at the bottom rear corner of the engine pod.
3. Install the exhaust pipe (**6**) to the exhaust/flex pipe (**8**).
4. Install the muffler (**4**) to the exhaust pipe (**6**).
5. Install the tail pipe (**10**) to the muffler (**4**).
6. Install the clamps (**3**) securing the tail pipe/muffler/ exhaust pipe to the frame mounted brackets.
7. Adjust the muffler, exhaust and tail pipes for proper clearance then tighten all clamps.
8. Install the exhaust heat shield (**2**).
9. Install the muffler heat shield (**1**).
10. Properly connect the battery.
11. Start engine and check for exhaust leaks at all exhaust connections. Adjust as needed.
12. Close and secure the engine cover.
13. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

7.8 AIR CLEANER ASSEMBLY

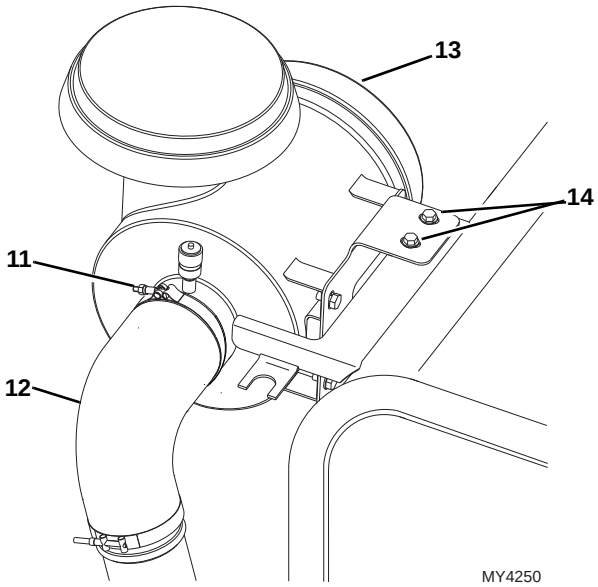
WARNING

NEVER run the engine with only the inner safety element installed.

Note: *Refer to the appropriate Operation & Safety Manual for your machine for the correct element change procedure.*

7.8.1 Air Cleaner Assembly Removal (John Deere & Perkins)

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Remove the clamp (**11**) securing the air intake elbow (**12**) to the air cleaner assembly (**13**). Pull the air intake elbow off the air cleaner.
6. Remove the capscrews and nuts securing the air cleaner mounting bracket (**14**) to the air cleaner mounting plate. Remove the air cleaner assembly.

7.8.2 Air Cleaner Assembly Installation (John Deere & Perkins)

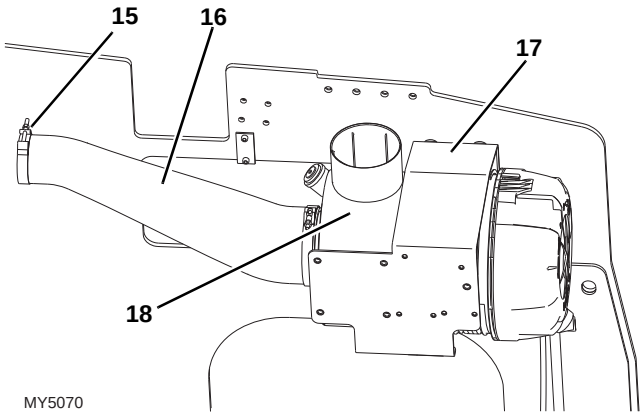
Note: *Apply Loctite® 242 to the capscrew threads before installation.*

1. Install the air cleaner assembly (**13**) to the cab mounting plate with the previously removed hardware (**14**).
2. Place the loosened clamp (**11**) over the air outlet elbow (**12**) and install elbow on the air cleaner assembly.
3. Adjust and tighten the clamp.
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

7.8.3 Air Cleaner Assembly Removal (Cummins)

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.

2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Loosen the clamp (**15**) securing the air intake elbow (**16**) engine.
6. Loosen the capscrews securing the air cleaner mounting bracket (**17**) to the engine fire wall.
7. Remove the air cleaner assembly (**17** & **18**).
8. Remove the air cleaner mounting bracket (**17**) from the air cleaner (**18**).

7.8.4 Air Cleaner Assembly Installation (Cummins)

Note: *Apply Loctite® 242 to the capscrew threads before installation.*

1. Install the air cleaner (**18**) to the air cleaner mounting bracket (**17**).
2. Install the air cleaner assembly (**17** & **18**) to the engine fire wall.
3. Tighten the previously loosened capscrews.
4. Install the air intake elbow (**16**) onto the engine.
5. Adjust and tighten the clamp (**15**).
6. Properly connect the battery.
7. Close and secure the engine cover.
8. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

7.9 ENGINE REPLACEMENT

7.9.1 Engine Removal

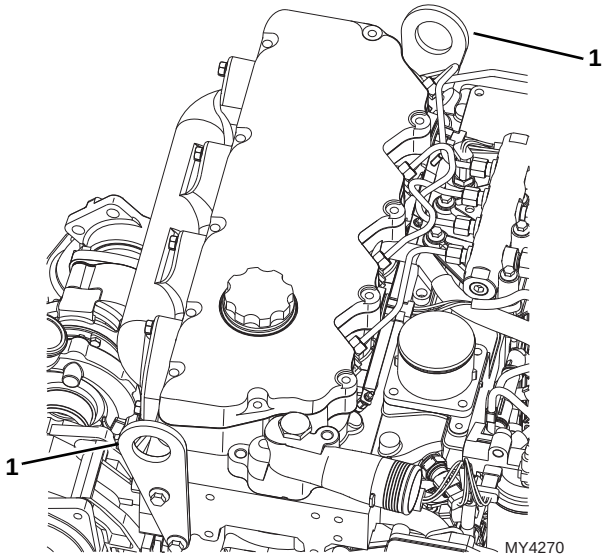
Note: *The radiator and oil cooler must be removed from the machine before engine removal. Refer to Section 7.4, "Engine Cooling System." Several additional components must be removed before engine removal. They will be addressed in the following procedures.*

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect and remove the battery. Properly disconnect and remove the second battery if equipped.
5. Remove the engine cover. Mark the position of the cover to help with cover adjustment when being reinstalled.
6. Remove the oil pan cover underneath the engine compartment.
7. Drain and remove the radiator assembly. Refer to Section 7.4.3, "Radiator/Oil Cooler and Replacement."
8. Remove the heater hoses attached to the engine (if equipped).

Note: *The engine harness is routed and attached to the engine using hold-down clamps and plastic wire ties at various places on the engine. Before removing engine, ensure that the harness has been completely separated (disconnected) from the engine. Move the harness clear of the engine, and with the help of an observer, ensure that the engine clears the harness during removal.*

9. Label and disconnect all electrical wire connections on the engine.
10. Label and disconnect all electrical wire connections on the Power Distribution bracket.
11. Remove the Power Distribution bracket.
12. Disconnect and cap the fuel inlet line at the fuel filter head.
13. Disconnect and cap the fuel return line from the fuel filter head.

14. Remove the exhaust pipe from the exhaust manifold. Refer to Section 7.7.1, “Exhaust System Removal.”
15. Loosen the clamps on the sleeve reducer at the engine and on the air suction pipe.
16. Remove the air cleaner tube assembly. Refer to Section 7.8.1, “Air Cleaner Assembly Removal (John Deere & Perkins),” or Section 7.8.3, “Air Cleaner Assembly Removal (Cummins).”
17. Remove the access plug from bottom of the engine bell housing. This will allow access to remove the bolts holding the torque convertor diaphragm to the engine flywheel.
18. Turn the engine over slowly by hand and align each of the four torque convertor diaphragm bolts to be accessed. Remove them one at a time.



19. Secure the engine with a lifting strap or chain from the appropriate lifting points (**1**). Use a suitable hoist or overhead crane.
20. Place a support or jack under the transmission to hold the transmission in place while engine is being removed.
21. Remove the bolts and washer securing the engine mounts.
22. Remove the ten bolts holding the transmission to the engine. Slightly lift and pull the engine out of the machine. Have an assistant ensure that the engine clears all frame components during removal.
23. Place engine on a flat, level surface.

7.9.2 Engine Installation

1. Secure the engine with a lifting strap or chain from the appropriate lifting points (**1**). Use a suitable hoist or overhead crane.

Note: *Apply Loctite® 242 to the engine mount bracket capscrew threads before installation.*

2. Install two guide studs in the bell housing holes.
3. Lift the engine and slowly push and lower into the engine bay. Have an assistant ensure that the engine clears the frame, hose and harness components during engine installation. Position engine brackets over the front frame mounts.
4. Push the engine towards the transmission aligning the guide studs and the torque convertor shaft with the corresponding holes.
5. Push the engine against the transmission and install eight of the ten bolts and washers. Remove both guide studs and replace with the remaining two bolts and washers. Torque bolts to 53-58 lb-ft (72-79 Nm).
6. Remove the support from under the transmission and lower the engine the remainder of the way onto the frame. Align the motor mount holes and install the bolts. Apply Loctite® 242 to the motor mount bolts and torque to 125-140 lb-ft (169-190 Nm).
7. Turn the engine over slowly by hand and align each of the four torque convertor diaphragm bolts through the access plug in the bell housing. Install them one at a time. DO NOT fully tighten until all of the capscrews and locknuts are in place. Torque to 26-39 lb-ft (35-59 Nm). Replace access plug.
8. Install the exhaust pipe. Refer to Section 7.7.2, “Exhaust System Installation.”
9. Install the complete air cleaner assembly. Refer to Section 7.8.2, “Air Cleaner Assembly Installation (John Deere & Perkins),” or Section 7.8.4, “Air Cleaner Assembly Installation (Cummins).”
10. Connect the fuel inlet line to the fuel filter head.
11. Connect the fuel return line to the fuel filter head.
12. Install the Power Distribution bracket.
13. Connect all the previously labeled electrical wire connections on the Power Distribution bracket.
14. Connect all the previously labeled electrical wire connections on the engine.
15. Install both heater hoses to the engine and tighten clamps (if equipped).
16. Install the complete radiator assembly. Refer to Section 7.4.3, “Radiator/Oil Cooler and Replacement.”

17. Install the engine cover and adjust.
18. Install and properly connect the battery. Install and properly connect the second battery if equipped.
19. Check that all hydraulic system, electrical system, cooling system, fuel system and exhaust system connections are correct and connected tightly.
20. From within the cab, lightly depress the throttle pedal to full-throttle position. As needed, adjust the limit-stop screw until it touches the pedal bracket.

Note: *Have an assistant stand by with a Class B fire extinguisher.*

21. Start the engine and run to normal operating temperature then shut off the engine. While the engine is cooling, check for leaks.
22. Allow the engine to cool. Check the radiator coolant level and add coolant if required. Replace the radiator cap.
23. Check for leaks from the engine, main hydraulic pump and lines, transmission, hydraulic reservoir and fuel tank. Check the levels of all fluids and lubricants. Fill as required.

Note: *During the full throttle check:*

- **DO NOT** operate any hydraulic function.
- **DO NOT** steer or apply any pressure to the steering wheel.
- Keep the transmission in (N) NEUTRAL.

24. Obtain and connect an appropriate engine analyzer or tachometer. Check the engine rpm at full throttle.
25. Purge the hydraulic system of air by operating all boom functions through their entire range of motion several times. Check the hydraulic oil level.
26. Check for proper operation of all components.
27. Turn the engine OFF.
28. Install the oil pan cover underneath the engine compartment.
29. Close and secure the engine cover.
30. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

7.10 TROUBLESHOOTING

Trouble	Possible Causes (see key, below)
Low Cranking Power	1, 2, 3, 4
Will Not Start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33
Difficult Starting	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 29, 31, 32, 33, 61, 63
Lack of Power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33, 61, 63
Misfiring	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32
Excessive Fuel Consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33, 63
Black Exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33, 61, 63
Blue/White Exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56, 62
Low Oil Pressure	4, 36, 37, 38, 39, 40, 42, 43, 44, 58
Knocking	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 59
Erratic Running	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 59
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 48, 49
High Oil Pressure	4, 38, 41
Overheating	11, 13, 14, 16, 18, 19, 24, 25, 45, 50, 51, 52, 53, 54, 57
Excessive Crankcase Pressure	25, 31, 33, 34, 45, 55, 60
Poor Compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 59
Starts and Stops	10, 11, 12

Key to Possible Causes

1. Battery charge low
2. Bad electrical connection
3. Faulty starter motor
4. Incorrect grade of lubricating oil
5. Low cranking speed
6. Fuel tank empty
7. Faulty stop control operation
8. Fuel inlet restricted
9. Faulty fuel lift pump
10. Clogged fuel filter
11. Restricted air cleaner
12. Air in fuel system
13. Faulty fuel injection pump
14. Faulty fuel injectors or incorrect type
15. Incorrect use of cold start equipment
16. Faulty cold start equipment
17. Broken fuel injection pump drive
18. Incorrect fuel pump timing
19. Incorrect valve timing
20. Poor compression
21. Blocked fuel tank vent
22. Incorrect grade of fuel
23. Sticking throttle or restricted movement
24. Exhaust pipe restriction
25. Leaking cylinder head gasket
26. Overheating
27. Cold running
28. Incorrect tappet adjustment
29. Sticking valves
30. Incorrect high pressure pipes
31. Worn cylinder bores
32. Pitted valves and seats
33. Broken, worn or sticking piston ring(s)
34. Worn valve stems and guides
35. Restricted air cleaner
36. Worn or damaged bearings
37. Insufficient oil in sump
38. Inaccurate gauge
39. Oil pump worn
40. Pressure relief valve sticking open
41. Pressure relief valve sticking closed
42. Broken relief valve spring
43. Faulty suction pipe
44. Restricted oil filter
45. Piston seizure/pick up
46. Incorrect piston height
47. Damaged fan
48. Faulty engine mounting
49. Incorrectly aligned flywheel housing or incorrectly aligned flywheel
50. Faulty thermostat
51. Restriction in water jacket
52. Loose fan belt
53. Restricted radiator
54. Faulty water pump
55. Restricted breather pipe
56. Damaged valve stem oil deflectors (if fitted)
57. Coolant level too low
58. Blocked sump strainer
59. Broken valve spring
60. Exhauster or vacuum pipe leak
61. Turbo impeller damaged or dirty
62. Turbo lubricating oil seal leak
63. Induction system leaks

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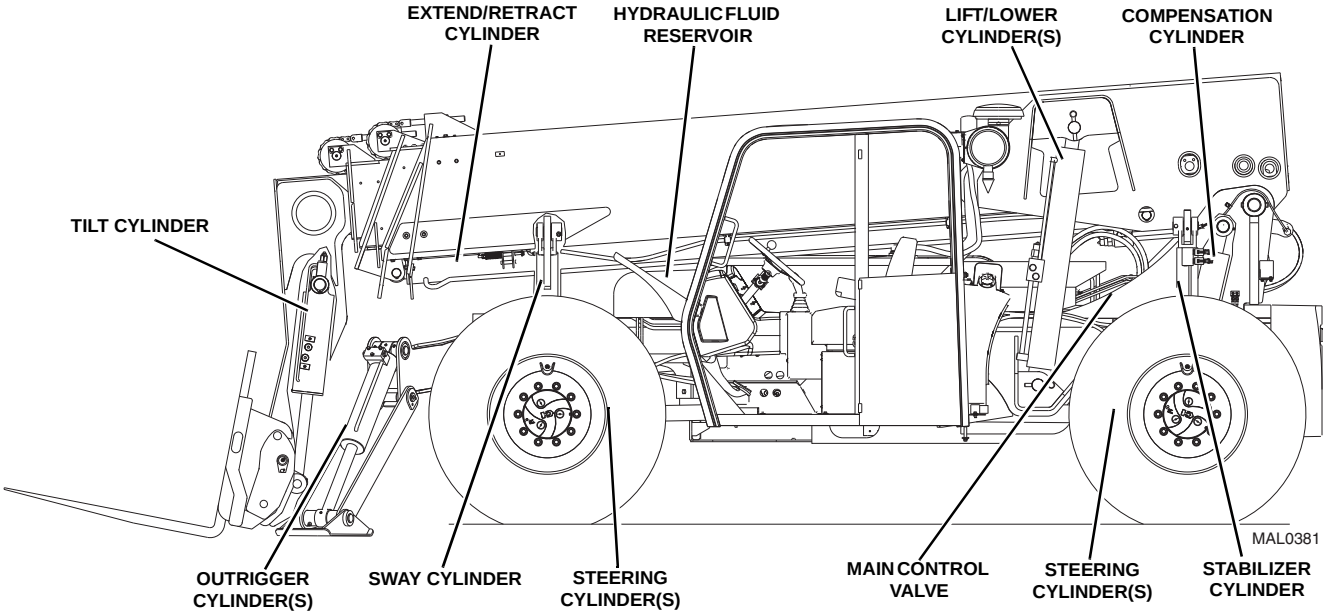
Section 8
Hydraulic System

Contents

PARAGRAPH	TITLE	PAGE
8.1	**Hydraulic Component Terminology**	**8-2**
8.2	**Safety Information**	**8-3**
8.3	**Hydraulic Pressure Diagnosis**	**8-3**
8.3.1	Pressure Checks and Adjustments	8-4
8.4	**Hydraulic Circuits**	**8-4**
8.4.1	Hydraulic Pressures	8-4
8.4.2	Tilt Circuit Port Relief Adjustment	8-5
8.4.3	Hydraulic Schematic	8-9
8.5	**Hydraulic Reservoir**	**8-13**
8.5.1	Hydraulic Oil Reservoir Draining	8-13
8.5.2	Hydraulic Oil Reservoir Filling	8-13
8.5.3	Hydraulic Oil Reservoir Removal/Installation	8-13
8.6	**Implement Pump**	**8-14**
8.6.1	Implement Pump Replacement	8-14
8.7	**Control Valves**	**8-15**
8.7.1	Main Control Valve	8-15
8.7.3	Service Brake Valve	8-17
8.7.4	Service Brake Bleeding	8-18
8.7.7	Steering Orbitrol Valve	8-19
8.7.8	Steer Select Valve	8-20
8.8	**Hydraulic Cylinders**	**8-21**
8.8.1	General Cylinder Removal Instructions	8-21
8.8.3	Cylinder Pressure Checking	8-23
8.8.4	Steering Cylinders	8-23
8.8.5	Cylinder Torque Specifications	8-24

8.1 HYDRAULIC COMPONENT TERMINOLOGY

To understand the safety, operation and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the hydraulic components of the machine. The following illustration identifies the components that are referred to throughout this section.



8.2 SAFETY INFORMATION

WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual.

Petroleum-based hydraulic fluids are used in this machine. The temperature of hydraulic fluid increases during the operation of various hydraulic functions. A heated petroleum-based hydraulic fluid presents a fire hazard, especially when an ignition source is present. Hydraulic fluid has a flash point that ranges from 300-600° F (150-318° C) and an auto-ignition temperature of 500-750° F (262-402° C).

Accordingly, periodically inspect all hydraulic system components, hoses, tubes, lines, fittings, etc. Carefully examine any deterioration and determine whether any further use of the component would constitute a hazard. If in doubt, replace the component.

Operate the hydraulic controls after the engine has stopped to relieve trapped pressure.

Note: *Residual pressure may remain in hydraulic cylinders, hoses, valve bodies, components, etc. If the hydraulic lines going to or coming from a component are taut, slowly and cautiously relieve (“bleed off”) pressure.*

Whenever you disconnect a hydraulic line, coupler, fitting or other component, slowly and cautiously loosen the part involved. A hissing sound or slow seepage of hydraulic fluid may occur in most cases. After the hissing sound has ceased, continue removing the part. Any escaping oil should be directed into an appropriate container. Cap or otherwise block off the part to prevent further fluid seepage.

Hydraulic system maintenance will, at times, require that the engine be operated. Always follow safety precautions.

A major cause of hydraulic component failure is contamination. Keeping the hydraulic fluid as clean as possible will help avoid downtime and repairs. Sand, grit and other contaminants can damage the finely machined surfaces within hydraulic components. If operating in an exceptionally dirty environment, change filters and inspect the fluid more often. When servicing the system, cap or plug hydraulic fittings, hoses and tube assemblies. Plug all cylinder ports, valves and the hydraulic reservoir, and pump openings until installation occurs. Protect threads from contamination and damage.

Some hydraulic functions are actuated by interfacing with electrical system components (switches, solenoids and sensors). When the hydraulic system is not functioning properly, check the electrical aspect of the malfunctioning circuit also. Refer to Section 9.5, “Electrical System Schematics,” in this manual.

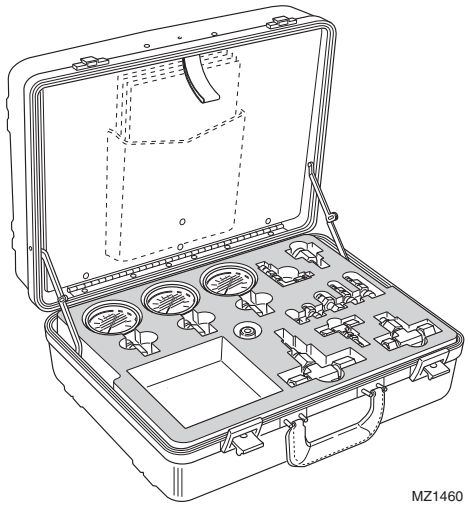
8.3 HYDRAULIC PRESSURE DIAGNOSIS

JLG Parts Department has a kit available to use for hydraulic system maintenance and troubleshooting: the JLG Pressure Test Kit. The kit is contained in a durable polyethylene carrying case for demanding field service conditions.

Hydraulic Pressure Test Kit

The hydraulic pressure test kit is used to pressure test the various hydraulic components in the hydraulic system. The kit includes:

- Gauges for testing high and low pressure circuits
- Fittings, couplers and hoses



MZ1460

Contact JLG Parts Department Toll Free at 1-877-554-5438 or 717-485-6472 for ordering information.

Part Number	Description	Approximate Weight	Price and Availability
70000652	Dial Hydraulic Pressure Test Kit	10 lbs.	Consult Factory
70000101	Digital Hydraulic Pressure Test Kit	7 lbs.	Consult Factory
70027911	Digital Hydraulic Pressure Test Kit	7 lbs.	Consult Factory

8.3.1 Pressure Checks and Adjustments

When diagnosing trouble in the hydraulic system, use the hydraulic testing information in Section 8.4.1, " Hydraulic Pressures."

In general, follow the steps below whenever conducting pressure checks and performing adjustments:

1. Park the machine on a firm, level surface. Engage the park brake, place the travel select lever in (N) NEUTRAL, level the boom and turn the engine OFF.
2. The test port is located at the top right corner of the main control valve. Install a pressure gauge capable of measuring at least 10% more pressure than that which the circuit being checked operates under.
3. Start the engine. Operate machine functions several times to allow hydraulic oil to reach operating temperature. The hydraulic oil temperature should be between 100-120°F (38-49° C). If a temperature gauge or thermometer is unavailable, the hydraulic oil reservoir should be warm to the touch.
4. Refer to Section 8.4.1, " Hydraulic Pressures." for testing procedures.
5. Fully depress the accelerator pedal if required. Place and hold the joystick in the position needed to operate the particular machine function being checked. Continue holding the joystick in position until pressure readings are taken.
6. Check the pressure gauge reading. It should read as specified in the Pressure Readings column of the charts found in Section 8.4.1, " Hydraulic Pressures." If the reading is not as specified, turn the engine OFF and check other components in the system. Verify that all related hydraulic components and electrical switches, sensors, solenoids, etc. are operating correctly.
7. Adjust the relief valve by turning the adjustment screw Turning clockwise will increase the pressure; turning the screw counterclockwise will decrease the pressure.
8. Start the engine and check the pressure again. Turn the engine OFF. If there is pressure reading in the gauge, bleed it off then disconnect or remove the pressure gauge from the machine.

8.4 HYDRAULIC CIRCUITS

This section covers the hydraulic circuits and includes listings for all hydraulic function pressures, where and how to check those pressures and a hydraulic schematic.

Electrical and hydraulic functions are often related. Verify that the electrical components of the circuit are functioning properly whenever troubleshooting the hydraulic circuit.

Always check the following before beginning to troubleshoot a circuit that is not functioning correctly.

1. Check the hydraulic oil level in the reservoir. Oil level should be to the middle of the sight glass with all cylinders retracted.
2. Check hoses, tubes, fittings and other hydraulic components for leaks, bends, kinks, interference, etc.
3. Check for air in the hydraulic system. Erratic machine performance and/or spongy cylinder operation are signs of air in the hydraulic system.

   If air in the hydraulic system is suspected, you will hear air leakage when hydraulic fittings are loosened and see air bubbles in the hydraulic fluid.

   Loose fittings, faulty o-rings or seals, trapped oil, leaks, system opened for service, etc., can cause air in the system. Determine what is causing air to enter the system and correct it. Bleed air from the system.

8.4.1 Hydraulic Pressures

a. Checking Pressure

1. Start the machine and warm the hydraulic system to operating temperature.
2. Shut off the machine and install a digital or a 5000 psi (345 bar) gauge to the appropriate test port on the hydraulic manifold.
3. Start the machine, run the engine at high idle and bottom the appropriate hydraulic function. Refer to Section 8.4.1, " Hydraulic Pressures." for the correct pressure rating.

b. Adjusting Hydraulic Pressure

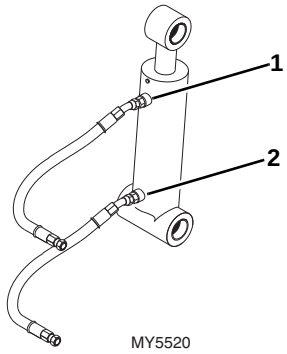
1. Shut the machine off. Remove the cap on the relief (if necessary).
2. Start the machine and loosen the jam nut on the relief. Turn the relief clockwise to increase pressure or counter-clockwise to decrease pressure. Set to the correct pressure.

3. Tighten the jam nut and recheck the pressure at full throttle. If the reading is within specification, shut the machine off, install the safety cap and remove the gauge from the test port.
4. If the proper pressure cannot be set, use the accompanying hydraulic schematic and/or the electrical schematic to help troubleshoot and correct the problem.

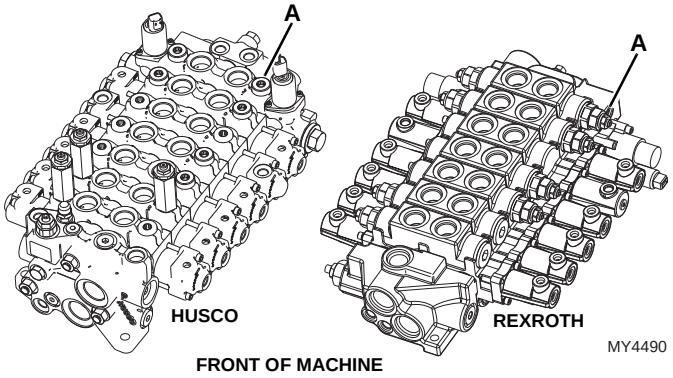
8.4.2 Tilt Circuit Port Relief Adjustment

The following procedure is specific to the tilt circuit only and should be performed and verified if the main and/or load sense circuits pressures are in question.

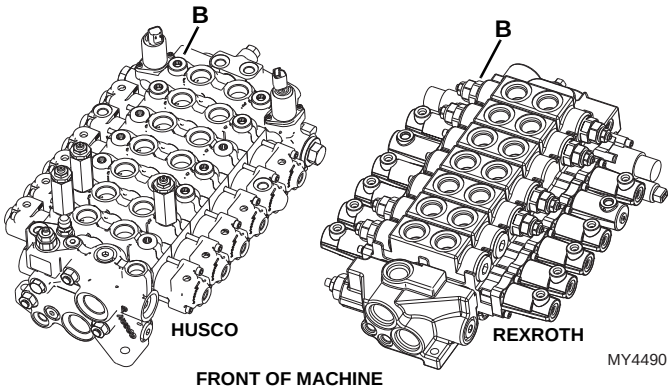
1. Remove any attachment from the quick coupler assembly. Refer to Section 3.9, “Quick Switch Assembly.”
2. Raise the boom for access to the compensation cylinder.



3. Slowly loosen and remove the retract (**1**) hose from the compensation cylinder.
4. Install a tee fitting to the retract (**1**) port of the compensation cylinder. Reconnect the previously removed retract (**1**) hose to the tee fitting.
5. Slowly loosen and remove the extend (**2**) hose from the compensation cylinder.
6. Install a tee fitting to the extend (**2**) port of the compensation cylinder. Reconnect the previously removed extend (**2**) hose to the tee fitting and cap the open port.
7. Install a digital or a 5000 psi (345 bar) gauge to the retract (**1**) port tee fitting on the compensation cylinder.
8. Start the machine and warm the hydraulic system to operating temperature.
9. Tilt the forks down to allow the tilt cylinder to fully retract.
10. Monitor the gauge and slowly raise the boom. The gauge should read 4100 psi (282 bar).
11. If pressure is correct, proceed to step 14.



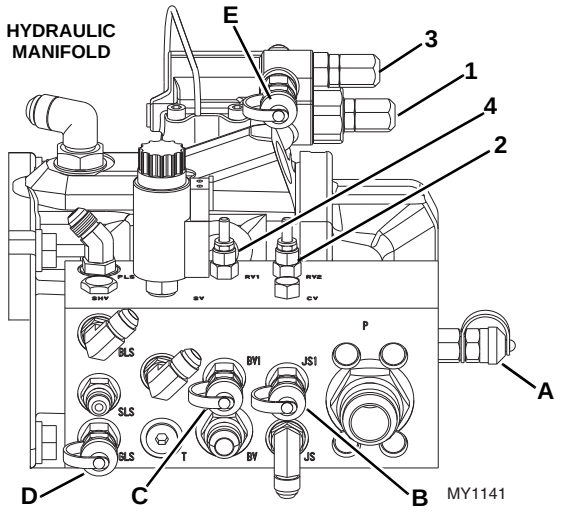
12. If the pressure requires adjustment and if the machine is equipped with a Rexroth main control valve, adjust the relief on the (**A**) port and repeat steps 9 and 10.
    If the machine is equipped with a Husco main control valve, the relief on the (**A**) port is non-adjustable and must be replaced. Replace and repeat steps 9 and 10.
13. Verify pressure is correct.
14. Shut engine OFF.
15. Remove the digital or the 5000 psi (345 bar) gauge from the retract (**1**) port tee fitting on the compensation cylinder and cap the open port.
16. Remove the cap and install a digital or a 5000 psi (345 bar) gauge to the extend (**2**) port tee fitting on the compensation cylinder.
17. Start the machine and if needed, warm the hydraulic system to operating temperature.
18. Tilt the forks up to allow the tilt cylinder to fully extend.
19. Monitor the gauge and slowly lower the boom. The gauge should read 4100 psi (282 bar).
20. If pressure is correct, proceed to step 23.



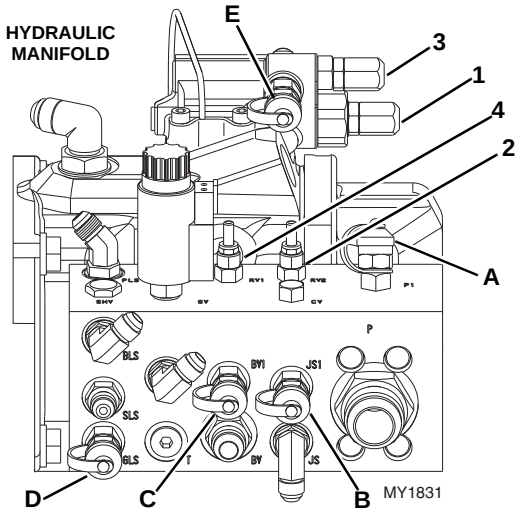
21. If the pressure requires adjustment and if the machine is equipped with a Rexroth main control valve, adjust the relief on the (**B**) port and repeat steps 17 and 18.
    If the machine is equipped with a Husco main control valve, the relief on the (**B**) port is non-adjustable and must be replaced. Replace and repeat steps 17 and 18.
22. Verify pressure is correct.
23. Shut engine OFF.
24. Slowly remove the gauge, line and tee fitting from the compensation cylinder (**1** & **2**). Reinstall each hose and torque as required.
25. Install any previously removed attachment.

a. Pressure Specifications
Before S/N 0160037877

Hydraulic Circuit	Test Port	Function Used to Test	Adjustment Location	Pressure Range
Main	P1 (**A**)	Bottom Tilt Down	1	3600-3650 psi (248-252 Bar)
Pilot	JS1 (**B**)	No Function	2	500-550 psi (34-38 Bar)
Standby	P1 (**A**)	No Function	3	750-775 psi (52-53 Bar)
Service Brake Supply	BV1 (**C**)	Bottom Steering, Any Mode	4	1000-1100 psi (69-76 Bar)
Steering	GLS (**D**)	Bottom Steering, Any Mode	5	2400-2500 psi (165-172 Bar)
Lift	LS2 (**E**)	Bottom Lift Down	6	3500-3525 psi (241-243 Bar)
Boom Retract	LS2 (**E**)	Bottom Boom Retract	7	3050-3075 psi (210-212 Bar)

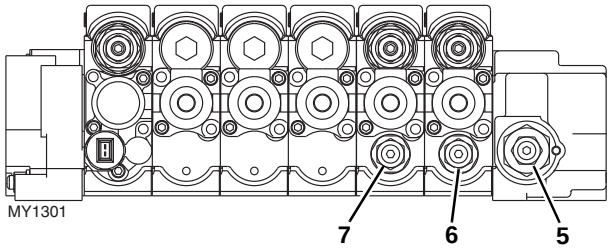


G10-55A - Before S/N 0160031864
G12-55A - Before S/N 0160030644



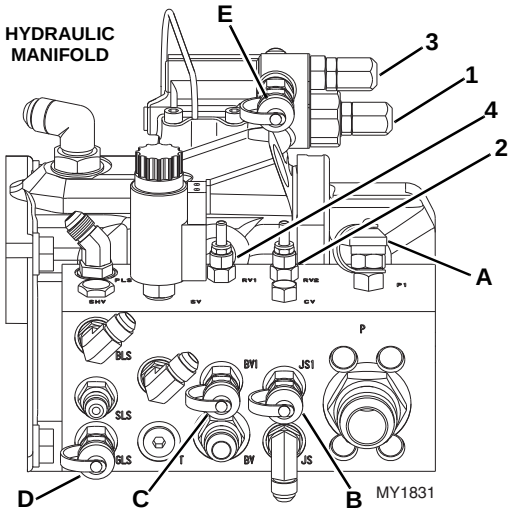
G10-55A - S/N 0160031864 & After
G12-55A - S/N 0160030644 & After

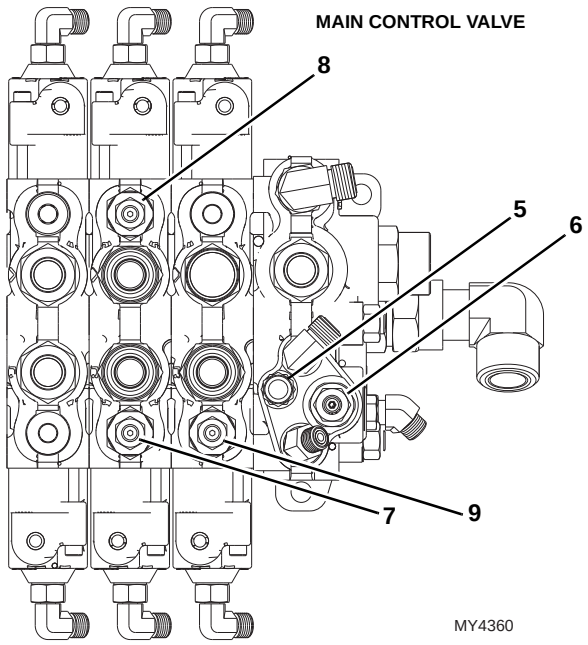
MAIN CONTROL VALVE



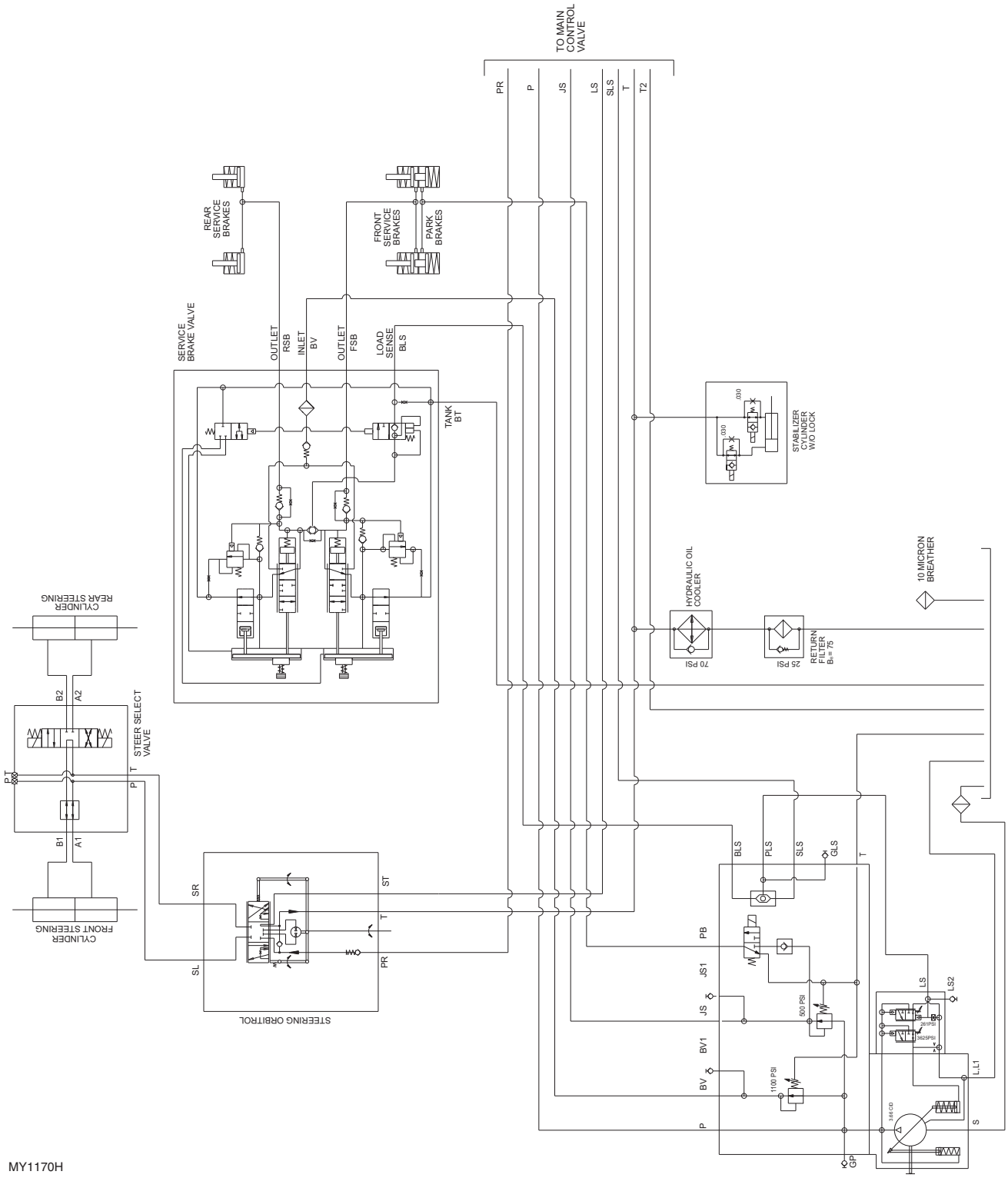
b. Pressure Specifications
S/N 0160037877 & After

Hydraulic Circuit	Test Port	Function Used to Test	Adjustment Location	Pressure Range
Main	P1 (**A**)	Bottom Tilt Down	1	3625-3700 psi (250-255 Bar)
Pilot	JS1 (**B**)	No Function	2	500-550 psi (34-38 Bar)
Standby	P1 (**A**)	No Function	3	750-775 psi (52-53 Bar)
Service Brake Supply	BV1 (**C**)	Bottom Steering, Any Mode	4	1050-1150 psi (72-79 Bar)
Steering	GLS (**D**)	Bottom Steering, Any Mode	5	2450-2550 psi (169-176 Bar)
Load Sense	LS2 (**E**)	Bottom Tilt Down	6	3350-3450 psi (231-238 Bar)
Boom Extend	LS2 (**E**)	Bottom Boom Extend	7	3300-3400 psi (227-234 Bar)
Boom Retract	LS2 (**E**)	Bottom Boom Retract	8	3300-3400 psi (227-234 Bar)
Lift	LS2 (**E**)	Bottom Lift Down	9	3300-3400 psi (227-234 Bar)
Auxiliary Hydraulic	LS2 (**E**)	Bottom Auxiliary Function	No Adjustment	3175-3325 psi (219-229 Bar)





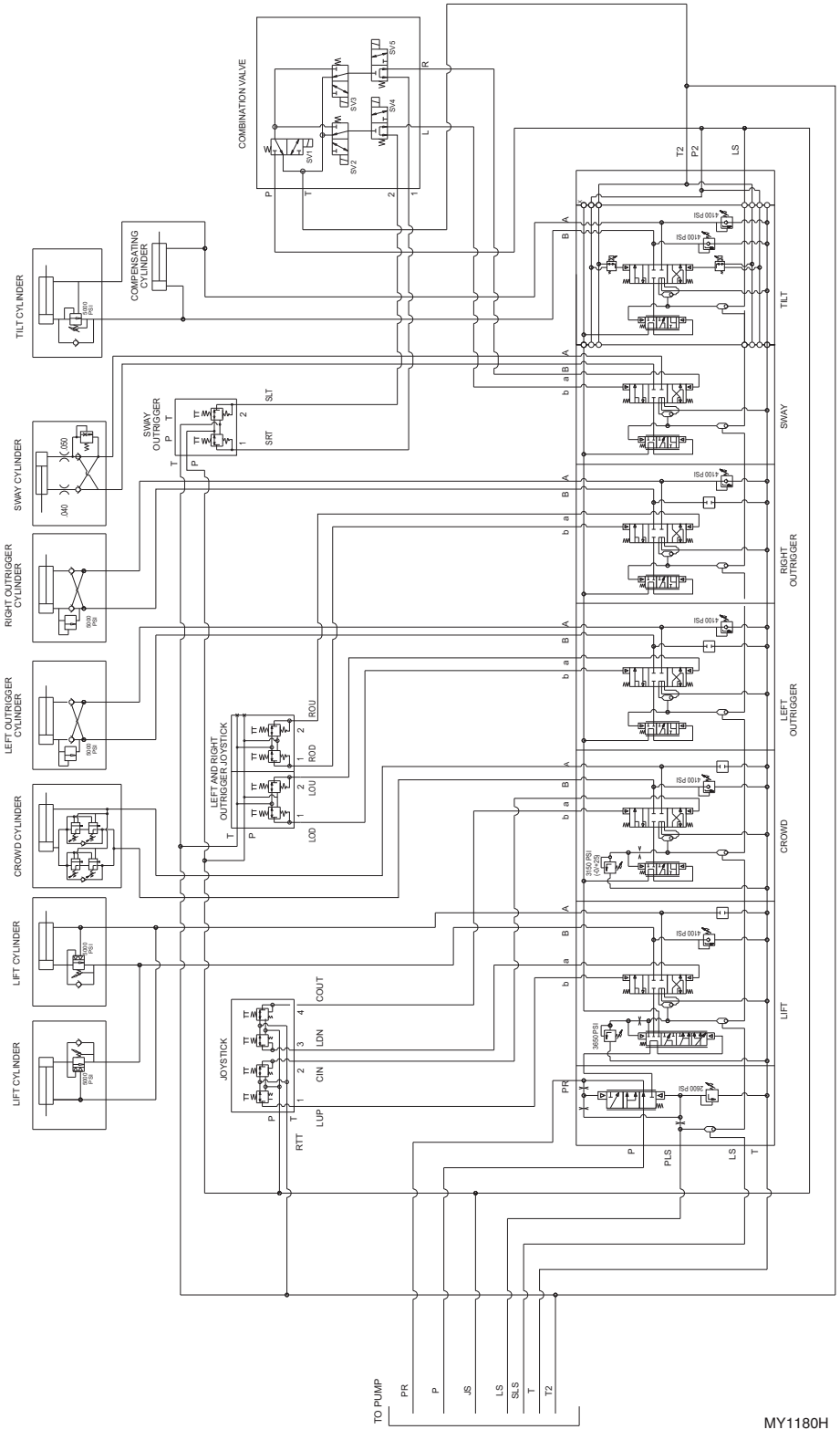
8.4.3 Hydraulic Schematic



MY1170H

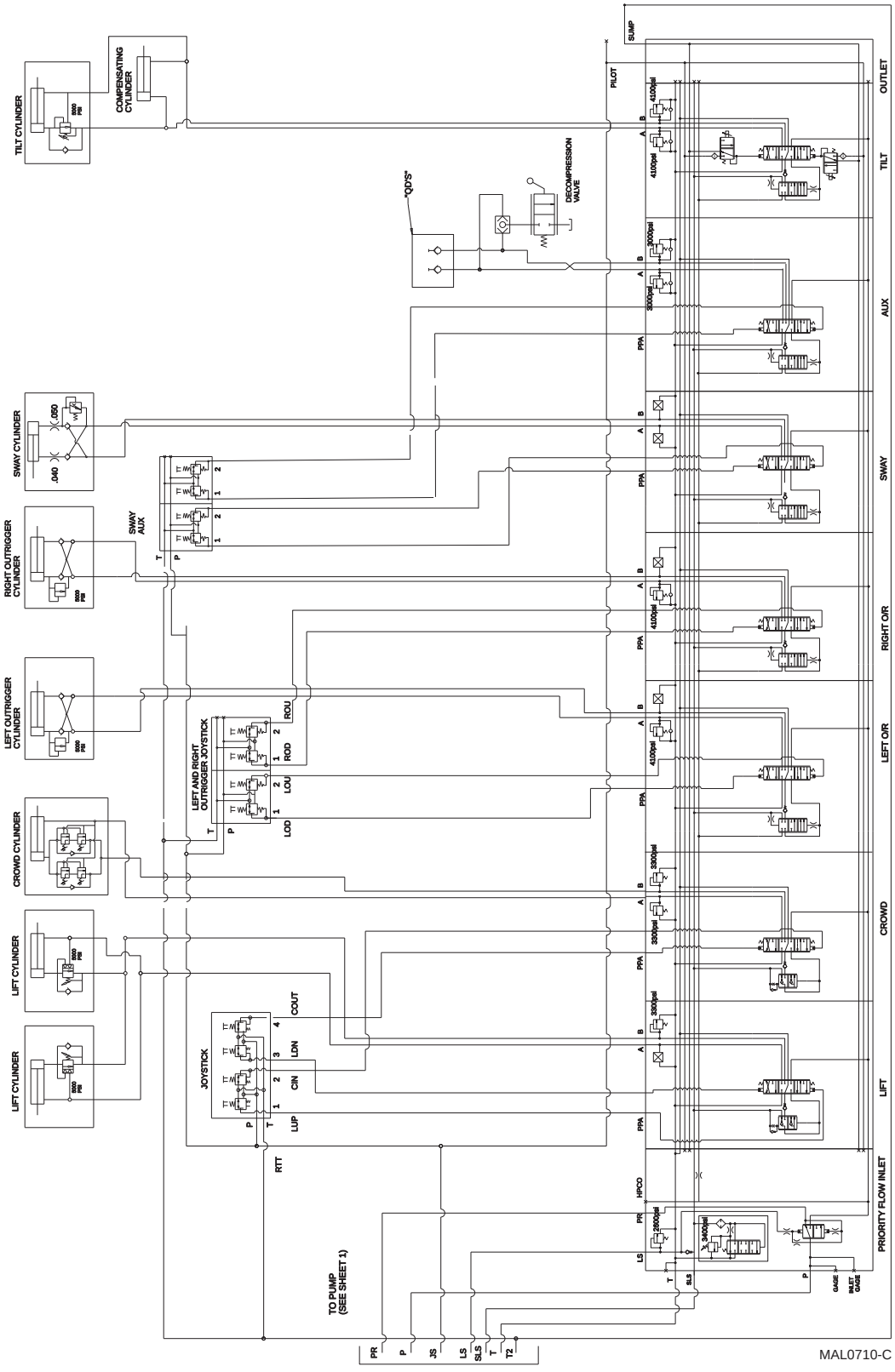
8.4.3 Hydraulic Schematic (Continued)

Before S/N 0160037877

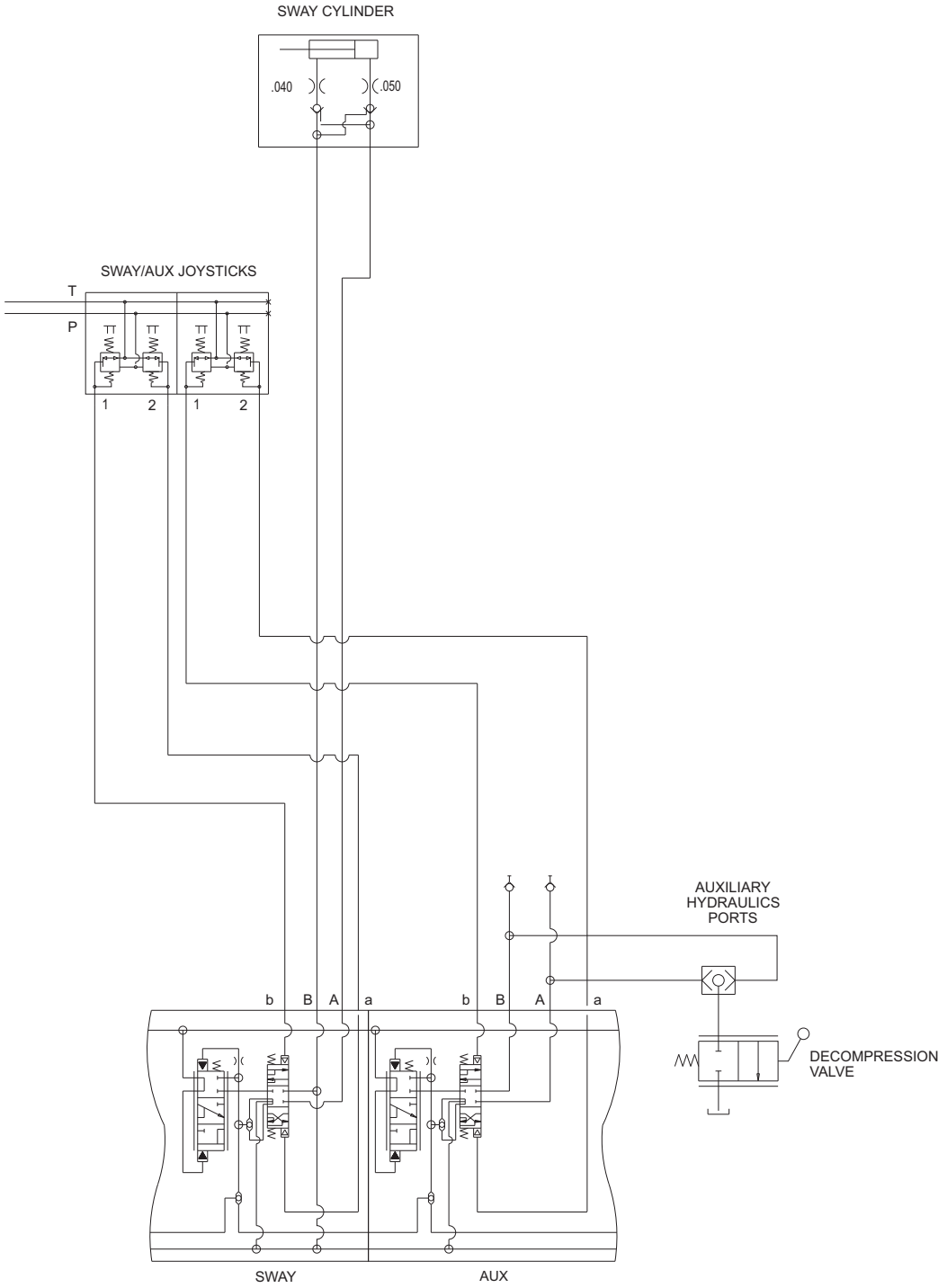


8.4.3 Hydraulic Schematic (Continued)

S/N 0160037877 & After



8.4.3 Hydraulic Schematic (Continued)

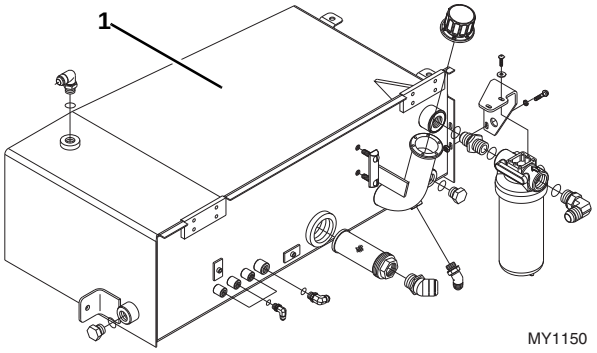


AUXILIARY HYDRAULICS OPTION

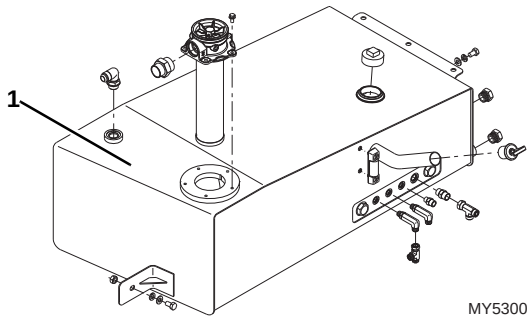
MY1190H

8.5 HYDRAULIC RESERVOIR

JOHN DEERE/PERKINS



CUMMINS



The hydraulic reservoir (**1**) is located on the frame between the engine compartment and the cab.

8.5.1 Hydraulic Oil Reservoir Draining

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Open the filler cap on the hydraulic oil reservoir. Remove the drain plug on the side of the hydraulic oil reservoir.
6. Transfer the used hydraulic oil into a suitable covered container, and label as "Used Oil". Dispose of used oil at an approved recycling facility. Clean and reinstall the drain plug.
7. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.

8.5.2 Hydraulic Oil Reservoir Filling

1. Be sure the reservoir is clean and free of all debris.
2. Install a new hydraulic oil filter.
3. Fill the reservoir with hydraulic oil. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

8.5.3 Hydraulic Oil Reservoir Removal/ Installation

If it is determined that the hydraulic oil reservoir must be removed, the hydraulic oil must be drained before the reservoir is removed. Always dispose of hydraulic oil properly.

a. Reservoir Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Drain the hydraulic oil reservoir. Refer to Section 8.5.1, “Hydraulic Oil Reservoir Draining.”
6. Label, disconnect and cap all hydraulic hoses attached to the hydraulic oil reservoir. Cap all fittings and openings to keep dirt & debris from entering the hydraulic system.
7. Remove the bolts securing the hydraulic oil reservoir to the frame.
8. Remove the hydraulic oil reservoir.

b. Disassembly

The hydraulic oil reservoir is a one-piece unit and cannot be disassembled. The hydraulic oil level sight- glass and hydraulic oil filler cap can be removed and reused on the new replacement reservoir. Dispose of the old reservoir according to local regulations concerning hazardous materials disposal.

c. Cleaning and Drying

If contaminated hydraulic oil or foreign material is in the tank, the tank can usually be cleaned.

Note: *If a leak is suspected in the hydraulic oil reservoir, contact your local distributor.*

To clean the hydraulic oil reservoir:

1. Have a dry chemical (Class B) fire extinguisher near the work area.
2. Remove the hydraulic oil reservoir drain plug, and safely drain any hydraulic oil into a suitable container. Dispose of hydraulic oil properly.
3. Clean the hydraulic oil reservoir with a high-pressure washer, or flush the tank with hot water for five minutes and drain the water. Dispose of contaminated water properly.

d. Inspection

1. Inspect the hydraulic oil reservoir thoroughly for any cracks, slices, leaks or other damage.
2. With the hydraulic oil reservoir removed from the machine, plug all openings except one elbow fitting. Install the elbow fitting, and apply approximately 1-1.5 psi (7-10 kPa) of air pressure through the elbow. Check the reservoir for leaks by applying a soap solution to the exterior and look for bubbles to appear at the cracked or damaged area.

e. Reservoir Installation

1. Place the hydraulic oil reservoir into its original orientation.
2. Secure the hydraulic oil reservoir to the frame with the previous mounting hardware.
3. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
4. Install the hydraulic fluid level sight-glass using special designed and drilled capscrews and gaskets.
5. Install hydraulic filter bracket and hydraulic filter.
6. Fill the hydraulic oil reservoir according to specifications. Refer to Section 2.4, “Fluid and Lubricant Capacities.”
7. Check the hydraulic oil reservoir for leaks.
8. Properly connect the battery.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

8.6 IMPLEMENT PUMP

For internal service instructions contact your local distributor.

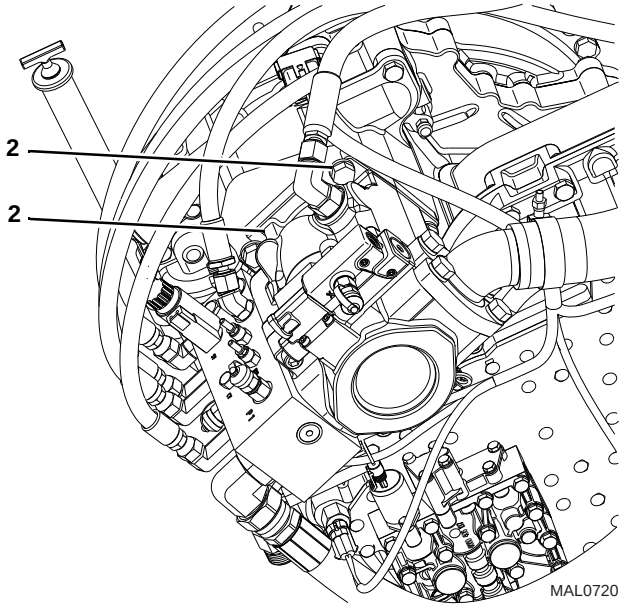
8.6.1 Implement Pump Replacement

a. Pump Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Drain the hydraulic reservoir. Refer to Section 8.5.1, “Hydraulic Oil Reservoir Draining.”
6. Thoroughly clean the pump and surrounding area, including all hoses and fittings before proceeding.

Note: *Cap all hoses as you remove them to prevent unnecessary fluid spillage.*

7. Label, disconnect and cap the hydraulic hoses attached to the pump.



8. Remove the four bolts and lockwashers (**2**) securing the pump to the transmission (top bolts shown only). Remove the o-ring located between the transmission and the pump. Wipe up any hydraulic oil spillage.

Note: *DO NOT disassemble the operating pump. The pump is pre-set from the manufacturer. Any adjustments or repairs performed by anyone other than an authorized dealer could void the warranty.*

b. Pump Installation

1. Place the pump and a new, oiled o-ring into position on the transmission. Align the pump shaft with the internal transmission gear, so that the machined teeth mesh together.
2. Align the bolt holes with the pump mount holes.
3. Apply Loctite® 242 to the previously removed bolts.
4. Secure the pump to the transmission with the four bolts and washers. Torque as required.
5. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
6. Fill the hydraulic reservoir. Refer to Section 8.5.2, “Hydraulic Oil Reservoir Filling.”
7. Prime the pump by filling the case drain port with fresh, filtered hydraulic oil from a clean container before installing the case drain connector and hose.
8. Check all routing of hoses and tubing for sharp bends or interference with any rotating members. All tube and hose clamps must be tight.
9. Remove the 10 amp fuse from location F3 in power distribution unit located in the engine compartment. This will allow the engine to crank, but not start while air is worked out of the new pump.
10. Connect a hose to the “P1” port on the pump. Direct the open end of the hose into a fluid drip pan.
11. Properly connect the battery.
12. Turn the machine ignition switch to START and back OFF in 3 to 5 second intervals. Monitor the open end of the drain hose for a constant flow of fluid (no air) while engine is cranking.
13. Once a constant flow is achieved at the open end of the drain hose, disconnect the hose and reinstall the 10 amp fuse to location F3 in the power distribution unit.
14. Inspect for leaks and check all fluid levels. The hydraulic reservoir oil level must be to the middle of the sight gauge.
15. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

c. Pump Test

Refer to Section 8.3.1, “Pressure Checks and Adjustments.”

8.7 CONTROL VALVES

8.7.1 Main Control Valve

The main control valve is mounted at the top of the chassis in front of the mast supports.

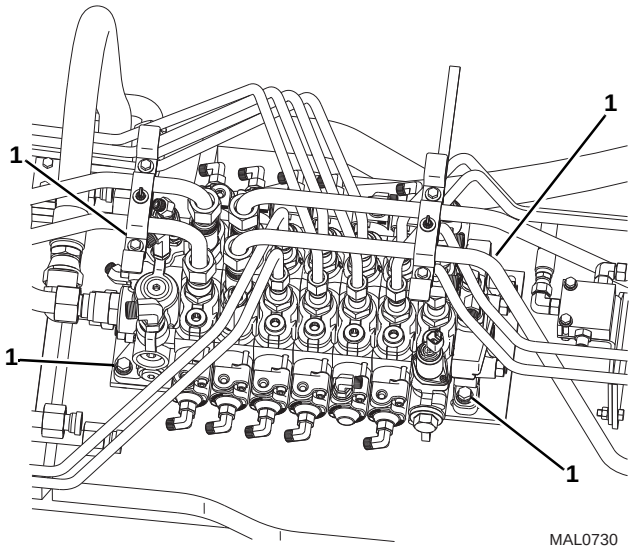
The main control valve assembly consists of individual working sections with their own valve assemblies, each providing a specific hydraulic function.

a. Main Control Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, raise the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Close the engine cover.
6. Remove the main valve cover.
7. Thoroughly clean the main control valve and surrounding area, including all hoses and fittings, before proceeding.
8. Drain the hydraulic fluid reservoir. Refer to Section 8.5.1, “Hydraulic Oil Reservoir Draining.”
9. Place a suitable container to catch hydraulic fluid drainage beneath the frame.

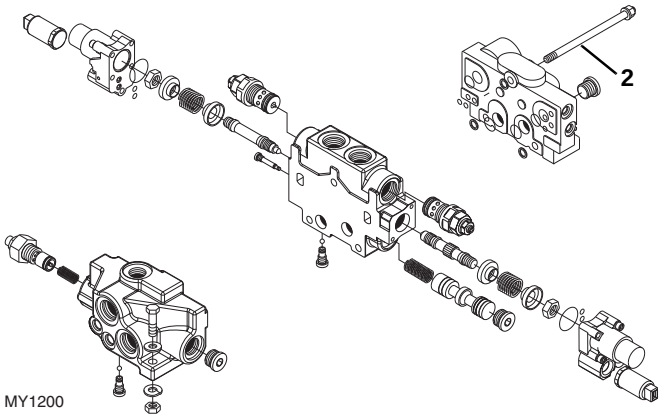
Note: *Slowly remove the hydraulic hoses attached to the main control valve to relieve any possible trapped pressure in the hydraulic line.*

10. Label, disconnect and cap all the hydraulic hoses, tubes and wires at the main control valve.
11. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.



12. Remove the four bolts, washers and nuts (**1**) securing the main control valve to the frame.

b. Main Control Valve Disassembly



1. To disassemble the individual sections of the main control valve, remove the nuts from one end of the tie rods (**2**). Pull the tie rods out through the sections.
2. Disassemble each section assembly as required.

Some sections include a pre-adjusted relief valve that regulates pressure in a specific circuit.

***Note: DO NOT** adjust any of the relief valve assemblies! Tampering with a relief valve will irrevocably alter pressure in the affected circuit, requiring recalibration or a new relief valve.*

Disassemble each Valve Section

1. Carefully separate the load sense outlet section from the lift/lower section.
2. Remove the o-rings from between the two sections.
3. Carefully separate each remaining sections, being careful not to lose the load sense shuttle ball.
4. Remove both end caps from each end of the valve sections then remove each control spool.
5. Remove any check valves, compensator valves, anti-cavitation valves or shock valves from individual valve section if equipped.
6. Keep all parts being removed from individual valve sections tagged and kept together.

c. Main Control Valve Parts Cleaning

Clean all components with a suitable cleaner, such as triclorethylene, before continuing. Blow dry.

d. Main Control Valve Parts Inspection

Inspect all parts and internal passageways for wear, damage, etc. If inner surfaces of any component **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the damaged part. Often, dirty hydraulic fluid causes failure of internal seals, damage to the polished surfaces within the component, and wear of and/or harm to other parts.

8.7.2 Main Control Valve Assembly

***Note:** ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

Assemble each Valve Section

1. Reassemble any check valves, compensator valves, anti-cavitation valves or shock valves from each individual valve sections if equipped.
2. Install the control spool being careful not to nick or scratch the valve section bore or the control spool.
3. Install the end caps on each end of the valve section.

Assemble the Main Control Valve.

1. Place all three tie rods (**2**) with the washers and nuts through the end main control valve section.
2. Stand the end main control valve section on end.
3. Install the proper o-rings and load sense shuttle on the inner face of the end main control valve section. Align the tilt control valve section over the three tie rods and slide onto the end main control valve section.

4. Using the proper o-rings and load sense shuttle, repeat step three for the remaining valve sections and lastly the inlet end valve section.
5. Install the three washers and nuts on the tie rods. Torque to 30 lb-ft (41 Nm).

e. Main Control Valve Installation

1. Install the main control valve onto the frame, aligning the bolts with the holes in the end sections of the main control valve. Slide the main control valve into position, and tighten the bolts.
2. Prime the main control valve by filling the inlet openings with fresh, filtered hydraulic oil from a clean container, before attaching the hoses.
3. Use new oiled o-rings as required. Uncap and connect all previously labeled hoses, clamps, etc. to the main control valve.
4. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
5. Fill the hydraulic fluid reservoir. Refer to Section 8.5.2, “Hydraulic Oil Reservoir Filling.”
6. Properly connect the battery.
7. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the machine or operating any hydraulic functions.
8. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
10. Install the main control valve cover.
11. Close and secure the engine cover.
12. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

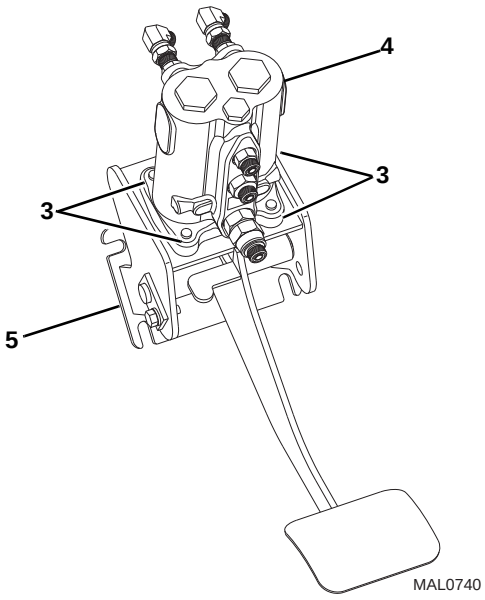
f. Main Control Valve Test

Conduct a pressure check of the hydraulic system in its entirety. Adjust pressure(s) as required. Refer to Section 8.3.1, “Pressure Checks and Adjustments.”

8.7.3 Service Brake Valve

a. Service Brake Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Label, disconnect and cap all hose attached to the service brake valve.
6. Remove the service brake pedal. Refer to Section 4.3.2, “Service Brake Pedal.”



7. Remove the four capscrews, four nuts and four lockwashers (**3**) mounting the service brake valve (**4**) to the service brake bracket (**5**).

Note: ***DO NOT*** *disassemble the service brake valve. The service brake valve is not serviceable and must be replaced in its entirety, if defective.*

b. Service Brake Valve Installation

1. Install the service brake valve (**4**) with the four capscrews, four lockwashers and four nuts (**3**) onto the service brake bracket (**5**).
2. Install the service brake pedal. Refer to Section 4.3.2, “Service Brake Pedal.”

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

3. Use new oiled o-rings as required. Uncap and connect the previously labeled hoses to the service brake valve.
4. Check the routing of all hoses, and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
5. Properly connect the battery.
6. Start the engine and run at approximately one-third to one-half throttle for about one minute, without moving the machine or operating any hydraulic functions.
7. Inspect the service brake valve and connections for leaks, and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

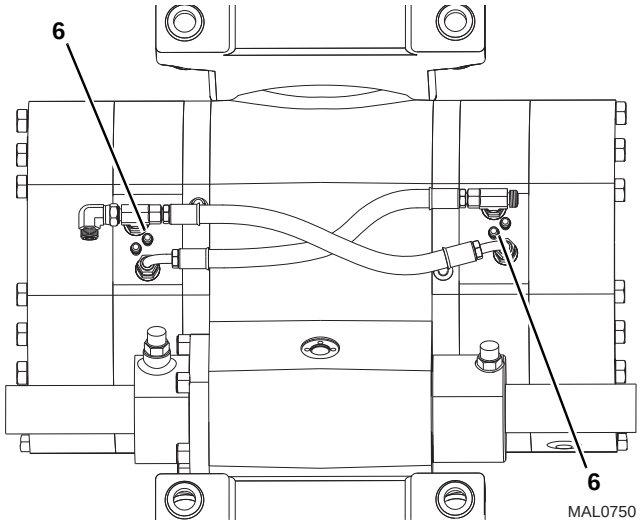
Note: *Check for leaks, and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

8.7.4 Service Brake Bleeding

Carefully bleed the brake lines as soon as the brake valve is installed in the machine. Air in the system will not allow the brakes to apply properly. There are four brake bleeder located on the front axle (two inner service brake bleeders and two outer park brake bleeders) and two service brake bleeders on the rear axle). Work with an assistant to perform this procedure.

1. Place the travel select lever in (N) NEUTRAL, engage the park brake, and start the engine.



2. Remove the plastic cap from one service brake bleeder (**6**). Attach one end of a length of transparent tubing over the brake bleeder. Place the other end of this tubing in a suitable transparent container that is partially filled with hydraulic oil. The end of the tubing must be below the oil level in the container.
3. Have the assistant depress the brake pedal. **DO NOT** open the service brake bleeder without holding the tubing firmly on the bleeder. There is pressure at the brakes. Carefully open the bleeder with a 12 mm. wrench. Close the service brake bleeder when air bubbles no longer appear in the oil. Release the brake pedal. Remove the tubing from the service brake bleeder.
4. Repeat Steps 2 and 3 for the remaining service brake bleeders.
5. Check hydraulic oil level and add if necessary.
6. Conduct a pressure and function check of the service brake. Refer to Section 8.4.1, “ Hydraulic Pressures.”

8.7.5 Service Brake Test

This procedure is used in order to determine if the service brake is functional. This procedure is not intended to measure the maximum brake performance. the brake holding torque that is required to sustain an engine torque at a specific engine rpm varies depending on the machine configuration. The variations are the differences in the engine settings, power train efficiency and in the brake holding ability, etc.

Conduct the following service brake test on a dry level surface, clear of any personnel and/or obstacles.

1. Place the travel select lever in (N) NEUTRAL, engage the park brake, and start the engine.
2. Raise the boom to a travel position.
3. Depress the service brake, disengage the parking brake and place the travel select lever in third gear forward.
4. Smoothly and controllably depress the throttle pedal.

Note: *Do Not hold the accelerator pedal in the fully depressed position for more than ten seconds. Damage to the power train could occur.*

5. Smoothly and controllably fully release the throttle pedal.
6. The machine should remain stationary during the test.
7. If the machine does not remain stationary during this test, contact the local distributor for proper service.
8. Engage the park brake, place the travel select lever in (N) NEUTRAL, lower the boom and shut engine OFF.

8.7.6 Park Brake Test

This procedure is used in order to determine if the parking brake is functional. This procedure is not intended to measure the maximum brake performance. the brake holding torque that is required to sustain an engine torque at a specific engine rpm varies depending on the machine configuration. The variations are the differences in the engine settings, power train efficiency and in the brake holding ability, etc.

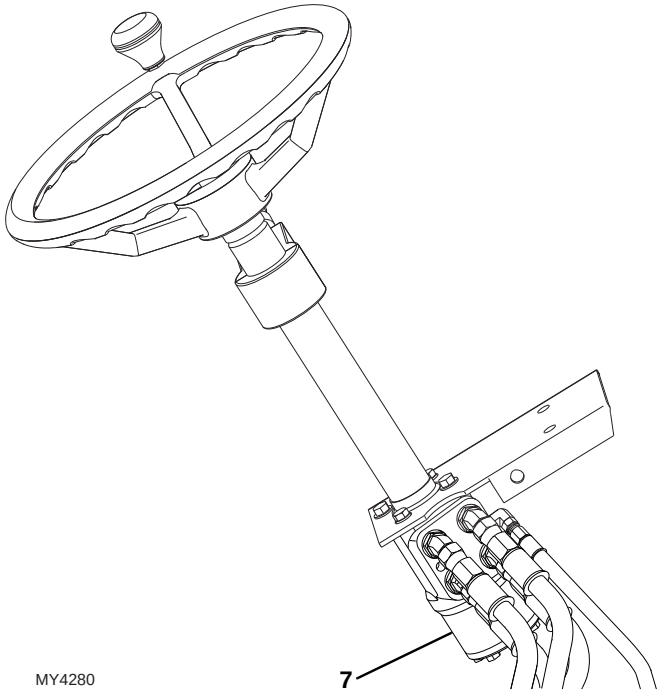
Conduct the following parking brake test on a dry level surface, clear of any personnel and/or obstacles.

1. Place the travel select lever in (N) NEUTRAL, engage the park brake, and start the engine.
2. Raise the boom to a travel position.
3. Depress the service brake, disengage and place the travel select lever in first gear forward.
4. Smoothly and controllably release the service brake.
5. Smoothly and controllably depress the throttle pedal.

Note: *Do Not hold the accelerator pedal in the fully depressed position for more than ten seconds. Damage to the power train could occur.*

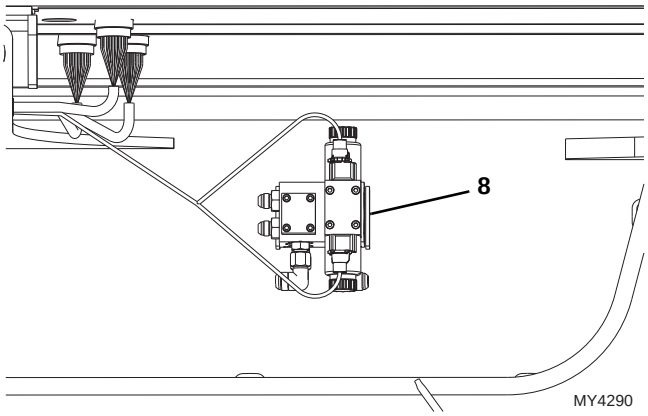
6. Smoothly and controllably fully release the throttle pedal.
7. The machine should remain stationary during the test.
8. If the machine does not remain stationary during this test, contact the local distributor for proper service.
9. Engage the park brake, place the travel select lever in (N) NEUTRAL, lower the boom and shut engine OFF.

8.7.7 Steering Orbitrol Valve



The steering orbitrol valve (**7**) is located at the base of the steering wheel shaft, concealed by the lower dash cover. The valve is not serviceable and must be replaced in its entirety if defective. For detailed information refer to Section 4.3.1, “Steering Column and Orbitrol Valve.”

8.7.8 Steer Select Valve



The machine can be used in the front-wheel, four-wheel or crab steering mode. The steer select valve (**8**) controls the direction of hydraulic fluid flow to the steering cylinder mounted on each axle. The steer select valve is attached to a mounting plate under the frame near the left front corner of the cab.

Verify the correct operation of the steer select valve solenoids before considering replacement of the valve. Refer to Section 9.5, “Electrical System Schematics,” and Section 9.11, “Display Monitor and Gauges.” The housing of the steer select valve is not serviceable and must be replaced if defective.

a. Steer Select Manifold and Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Label, disconnect and cap the hydraulic hoses and the electrical plugs connected to the steering select valve.
6. Remove the bolts holding the steer select valve to the mounting plate on the frame.
7. Remove the steer select manifold with the attached steer select valve from the machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Steer Select Manifold and Valve Disassembly, Cleaning, Inspection and Assembly

1. Place the steer select assembly on a suitable work surface.
2. Separate the steer select valve from the manifold by removing the four socket head capscrews. Discard the four o-rings.
3. Remove the solenoid valves and cartridges from the steer select housing.
4. Clean all components with a suitable cleaner before inspection.
5. Inspect the solenoid cartridges for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
6. Inspect internal passageways of the steer select manifold and valve for wear, damage, etc. If inner surfaces of the manifold DO NOT display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the secondary function manifold.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

7. Install the solenoid valves and cartridges in the steer select housing.
8. Attach the steer select valve to the manifold using four new, oiled o-rings and the four socket head capscrews.

c. Steer Select Valve and Manifold Installation

1. Install the steer select valve to the mounting plate under the left front side of the frame using the two bolts.
2. Connect all the hydraulic hoses, fittings, solenoid wire terminal leads, etc., to the steer select valve
3. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.
4. Properly connect the battery.
5. Start the engine and run at approximately 1/3-1/2 throttle for about one minute without moving the machine or operating any hydraulic functions.

6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
8. Close and secure the engine cover.
9. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

d. Steering Test

Refer to Section 8.4.1, " Hydraulic Pressures."

1. Conduct a pressure check of the steering hydraulic circuit.
2. Check each steering mode for proper function.

8.8 HYDRAULIC CYLINDERS

8.8.1 General Cylinder Removal Instructions

1. Remove any attachment from the machine. Park the machine on a firm level surface and fully retract the boom. Allow sufficient work space around the hydraulic cylinder being removed. Support the boom if the lift/lower cylinder is being removed. Place the travel select lever in (N) NEUTRAL, engage the park brake, shut the engine OFF and chock wheels.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Label, disconnect and cap or plug hydraulic hoses in relation to the cylinder.
6. Attach a suitable sling to an appropriate lifting device and to the cylinder. Make sure the device used can actually support the cylinder.
7. Remove the lock bolt and/or any retaining clips securing the cylinder pins. Remove the cylinder pins.
8. Remove the cylinder.
9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.

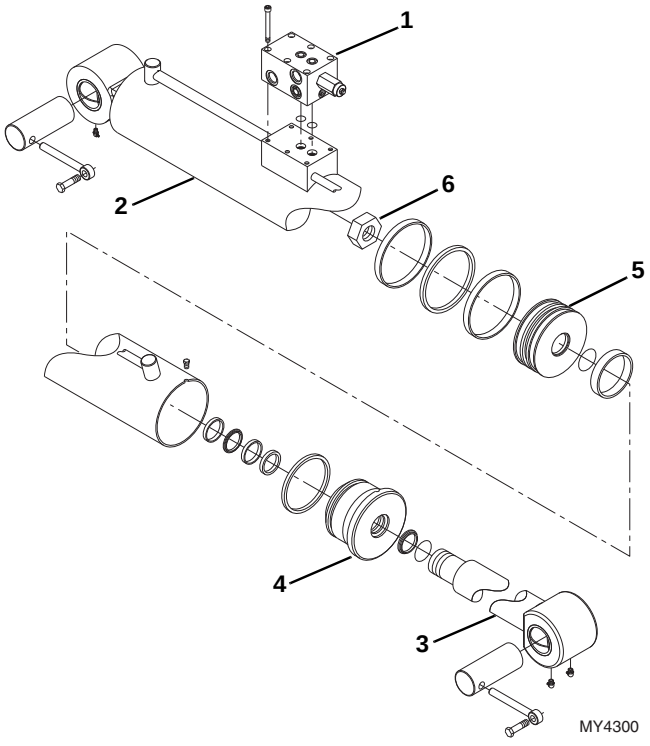
a. General Cylinder Disassembly

1. Clean the cylinder with a suitable cleaner before disassembly. Remove all dirt, debris and grease from the cylinder.
2. Clamp the barrel end of the cylinder in a soft-jawed vise or other acceptable holding equipment if possible.

⚠ WARNING

Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder.

Note: *Avoid using excessive force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube.*



3. If applicable, remove the counterbalance valve (**1**) from the side of the cylinder barrel (**2**).

Note: *DO NOT tamper with or attempt to adjust the counterbalance valve cartridge. If adjustment or replacement is necessary, replace the counterbalance valve with a new part.*

4. Extend the rod (**3**) as required to allow access to the base of the cylinder.

Note: *Protect the finish of the rod at all times. Damage to the surface of the rod can cause seal failure.*

5. Using a pin spanner wrench, unscrew the head gland (**4**) from the tube (**2**). A considerable amount of force will be needed to remove the head gland.
6. Carefully slide the head gland down along the rod toward the rod eye, away from the cylinder barrel.

Note: *When sliding the rod and piston assembly out of the barrel, prevent the threaded end of the barrel from damaging the piston. Keep the rod centered within the barrel to help prevent binding.*

7. Carefully pull the rod assembly (**3**) along with the head gland (**4**) out of the cylinder barrel.
8. Fasten the rod eye in a soft-jawed vise, and place a padded support under and near the threaded end of the rod to prevent any damage to the rod.
9. Remove the set screw from the piston head (**5**).
10. If equipped, remove the piston head (**5**) mounting nut (**6**).

Note: *It may be necessary to apply heat to break the bond of the sealant between the piston and the rod before the piston can be removed.*

Some cylinder parts are sealed with a special organic sealant and locking compound. Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded parts. Wipe off any hydraulic oil, then heat the part(s) uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating, or the parts may become distorted or damaged. Apply sufficient torque for removal while the parts are still hot. The sealant often leaves a white, powdery residue on threads and other parts, which must be removed by brushing with a soft brass wire brush prior to reassembly.

11. Remove the piston head (**5**) from the rod (**3**) and carefully slide the head gland (**4**) off the end of the rod.
12. Remove all seals, back-up rings and o-rings from the piston head and all seals, back-up rings and o-rings from the head gland.

Note: *The head gland bearing will need to be inspected to determine if replacement is necessary.*

DO NOT attempt to salvage cylinder seals, sealing rings or o-rings. ALWAYS use a new, complete seal kit when rebuilding hydraulic components. Consult the parts catalog for ordering information.

b. Cylinder Cleaning Instructions

1. Discard all seals, back-up rings and o-rings. Replace with new items from seal kit to ensure proper cylinder function.
2. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: *If a white powdery residue is present on threads or parts, it can be removed by using a soft brass wire brush. Wipe clean with Loctite® Cleaner prior to reassembly.*

8.8.2 Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the cylinder barrel does not display a smooth finish, or is scored or damaged in any way, replace the barrel.
2. Remove light scratches on the piston, head gland, rod or inner surface of the cylinder barrel with a 400-600 grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Check the piston rod assembly for run-out. If the rod is bent, it must be replaced.

c. General Cylinder Assembly Instructions

1. Use the proper tools for specific installation tasks. Clean tools are required for installation.
2. Install new seals, back-up rings and o-rings on the piston and new seals, back-up rings, o-rings and bearing on the head gland.

Note: *The extend/retract cylinder has a spacer that MUST be installed over the rod AFTER the head gland and BEFORE the piston head.*

3. Fasten the rod eye in a soft-jawed vise, and place a padded support under and near the threaded end of the rod to prevent any damage to the rod.

Note: *Protect the finish on the cylinder rod at all times. Damage to the surface of the rod can cause seal failure.*

4. Lubricate and slide the head gland over the cylinder rod. Install the piston head on to the end of the cylinder rod. Loctite® and install the set screw in the piston head. Refer to Section 8.8.5, “Cylinder Torque Specifications” for torque specifications for the piston head and the set screw.

Note: *Avoid using excess force when clamping the cylinder barrel in a vise. Apply only enough force to hold the cylinder barrel securely. Excessive force can damage the cylinder barrel.*

5. Place the cylinder barrel in a soft-jawed vise or other acceptable holding devise.

Note: *When sliding the rod and piston assembly into the cylinder barrel, prevent the threaded end of the cylinder barrel from damaging the piston head. Keep the cylinder rod centered within the barrel to prevent binding.*

6. Carefully insert the cylinder rod assembly into the cylinder barrel.
7. Screw the head gland into the cylinder barrel and tighten with a spanner wrench. Refer to Section 8.8.5, “Cylinder Torque Specifications” for torque specifications for the head gland.
8. If applicable, install new counter balance valve into block on the cylinder barrel.

d. General Cylinder Installation

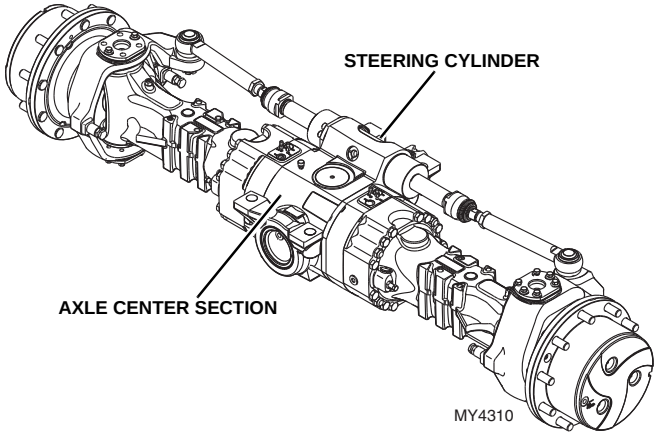
1. Grease the bushings at the ends of the hydraulic cylinder. Using an appropriate sling, lift the cylinder into it’s mounting position.
2. Align cylinder bushing and install pin, lock bolt or retaining clip.
3. Connect the hydraulic hoses in relation to the labels or markings made during removal.
4. Before starting the machine, check fluid level of the hydraulic fluid reservoir and if necessary fill to full mark with hydraulic oil.
5. Properly connect the battery.
6. Start the machine and run at low idle for about one minute. Slowly activate hydraulic cylinder function in both directions allowing cylinder to fill with hydraulic oil.
7. Inspect for leaks and check level of hydraulic fluid in reservoir. Add hydraulic fluid if needed. Shut the engine OFF.
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

8.8.3 Cylinder Pressure Checking

Attach a 5000 psi (345 bar) gauge to the test port on the P1 port on the hydraulic manifold to check the system pressure. For more information, refer to Section 8.4.1, “ Hydraulic Pressures.”

Note: *If a hydraulic cylinder pressure is greater than the main control valve pressure, increase the main control valve pressure by adjusting the main relief. Generally, one half turn clockwise will be adequate to check an individual circuit. Activate the circuit and if pressure is obtained turn the main relief counter clockwise one half turn. Re-check the main relief setting and adjust if necessary.*

8.8.4 Steering Cylinders



The steer cylinder is attached to each axle center housing.The steer cylinder assembly can be found in Section 5.3, “Axle Assemblies.” The steer cylinder is covered in the appropriate manufacturer’s axle literature.

8.8.5 Cylinder Torque Specifications

a. Lift/Lower Cylinder

	Head	Nut	CB Valve	CB Cap Screw
G10-55A - Before S/N 0160033659 excluding 0160033452	550-600 lb-ft (745-813 Nm)	2125-2175 lb-ft (2881-2949 Nm)	45-50 lb-ft (54-61 Nm)	28-30 lb-ft (38-41 Nm)
G10-55A - S/N 0160033659 thru 0160035822 including 0160033452		1600-2000 lb-ft (2169-2711 Nm)	30-35 lb-ft (40-47 Nm)	24-27 lb-ft (32-36 Nm)
G10-55A - S/N 0160035822 & After	755-923 lb-ft (1024-1251 Nm)	1600-2000 lb-ft (2169-2711 Nm)	30-35 lb-ft (40-47 Nm)	24-27 lb-ft (32-36 Nm)
G12-55A - Before S/N 0160033659 excluding 0160033452	550-600 lb-ft (745-813 Nm)	2850-2900 lb-ft (3864-3932 Nm)	45-50 lb-ft (54-61 Nm)	28-30 lb-ft (38-41 Nm)
G12-55A - S/N 0160033659 thru 0160035879 including 0160033452		1600-2000 lb-ft (2169-2711 Nm)	45-50 lb-ft (54-61 Nm)	24-27 lb-ft (32-36 Nm)
G12-55A - S/N 0160035879 & After	755-923 lb-ft (1024-1251 Nm)	1600-2000 lb-ft (2169-2711 Nm)	45-50 lb-ft (54-61 Nm)	24-27 lb-ft (32-36 Nm)

b. Extend/Retract Cylinder

	Head	Nut	CB Valve (Large)	CB Valve (Small)
G10-55A - Before S/N 0160033661	500-550 lb-ft (678-745 Nm)	1325-1375 lb-ft (1796-1864 Nm)	110 lb-ft (149 Nm)	35 lb-ft (47 Nm)
G10-55A - S/N 0160033661 thru 0160035822		1400-1700 lb-ft (1796-1864 Nm)	110 lb-ft (149 Nm)	33 lb-ft (44 Nm)
G10-55A - S/N 0160035822 & After		1400-1700 lb-ft (1796-1864 Nm)	110 lb-ft (149 Nm)	33 lb-ft (44 Nm)
G12-55A - Before S/N 0160033659 excluding 0160033452	500-550 lb-ft (678-745 Nm)	1325-1375 lb-ft (1796-1864 Nm)	110 lb-ft (149 Nm)	35 lb-ft (47 Nm)
G12-55A - S/N 0160033659 thru 0160035879 including 0160033452		1400-1700 lb-ft (1796-1864 Nm)	110 lb-ft (149 Nm)	33 lb-ft (44 Nm)
G12-55A - S/N 0160035879 & After		1400-1700 lb-ft (1796-1864 Nm)	110 lb-ft (149 Nm)	33 lb-ft (44 Nm)

c. Tilt Cylinder

	Head	Nut	CB Valve
G10-55A - Before S/N 0160033661	550-600 lb-ft (745-813 Nm)	2050-2100 lb-ft (2779-2847 Nm)	44 lb-ft (60 Nm)
G10-55A - S/N 0160033661 thru 0160035822		2200-2400 lb-ft (2982-3254 Nm)	44 lb-ft (60 Nm)
G10-55A - S/N 0160035822 thru 0160037689		2200-2400 lb-ft (2982-3254 Nm)	44 lb-ft (60 Nm)
G10-55A - S/N 0160037689 & After	500-600 lb-ft (678-813 Nm)	2200-2500 lb-ft (2982-3389 Nm)	40-45 lb-ft (54-61 Nm)
G12-55A - Before S/N 0160033659 excluding 0160033452	550-600 lb-ft (745-813 Nm)	2250-2300 lb-ft (3050-3118 Nm)	44 lb-ft (60 Nm)
G12-55A - S/N 0160033659 thru 0160035879 including 0160033452		2400-2600 lb-ft (3254-3525 Nm)	44 lb-ft (60 Nm)
G12-55A - S/N 0160035879 thru 0160037689		2400-2600 lb-ft (3254-3525 Nm)	44 lb-ft (60 Nm)
G12-55A - S/N 0160037689 & After	500-600 lb-ft (678-813 Nm)	2200-2500 lb-ft (2982-3389 Nm)	40-45 lb-ft (54-61 Nm)

d. Compensation Cylinder

	Head	Nut
G10-55A - Before S/N 0160033659 excluding 0160033452	550-600 lb-ft (745-813 Nm)	2050-2100 lb-ft (2779-2847 Nm)
G10-55A - S/N 0160033659 thru 0160037689 including 0160033452		2200-2400 lb-ft (2982-3254 Nm)
G10-55A - S/N 0160037689 & After		2200-2400 lb-ft (2982-3254 Nm)
G12-55A - Before S/N 0160033659 excluding 0160033452	600 lb-ft (813 Nm)	2250-2300 lb-ft (3050-3118 Nm)
G12-55A - S/N 0160033659 thru 0160037689 including 0160033452		1600-2000 lb-ft (2169-2712 Nm)
G12-55A - S/N 0160037689 & After		1600-2000 lb-ft (2169-2712 Nm)

e. Sway Cylinder

	Head	Nut	Check Valve
G10-55A - Before S/N 0160033661	300-325 lb-ft (407-441 Nm)	750-800 lb-ft (1016-1085 Nm)	15 lb-ft (20 Nm)
G10-55A - S/N 0160033661 thru 0160037690		1125-1375 lb-ft (1525-1864 Nm)	33 lb-ft (45 Nm)
G10-55A - S/N 0160037690 & After		1125-1375 lb-ft (1525-1864 Nm)	33 lb-ft (45 Nm)
G12-55A - Before S/N 0160033659 excluding 0160033452	300-325 lb-ft (407-441 Nm)	750-800 lb-ft (1016-1085 Nm)	15 lb-ft (20 Nm)
G12-55A - S/N 0160033659 thru 0160035879 including 0160033452		1125-1375 lb-ft (1525-1864 Nm)	33 lb-ft (45 Nm)
G12-55A - S/N 0160035879 & After		1125-1375 lb-ft (1525-1864 Nm)	33 lb-ft (45 Nm)

f. Stabilizer Cylinder

	Head	Nut	Cartridge	Cartridge Nut
G10-55A - Before S/N 0160033661	300-325 lb-ft (407-441 Nm)	775-825 lb-ft (1050-1119 Nm)	22 lb-ft (30 Nm)	2.5 lb-ft (3,3 Nm)
G10-55A - S/N 0160033661 & After		800-1000 lb-ft (1085-1356 Nm)	22 lb-ft (30 Nm)	2.5 lb-ft (3,3 Nm)
G12-55A - Before S/N 0160033659 excluding 0160033452	300-325 lb-ft (407-441 Nm)	775-825 lb-ft (1050-1119 Nm)	22 lb-ft (30 Nm)	2.5 lb-ft (3,3 Nm)
G12-55A - S/N 0160033659 & After including 0160033452		800-1000 lb-ft (1085-1356 Nm)	22 lb-ft (30 Nm)	2.5 lb-ft (3,3 Nm)

g. Outrigger Cylinder

Head	Nut	Valve Mount
100-400 lb-ft (136-542 Nm)	1300-1350 lb-ft (1762-1830 Nm)	30-35 lb-ft (41-47 Nm)
100-400 lb-ft (136-542 Nm)	1100 lb-ft (1491 Nm)	30-35 lb-ft (41-47 Nm)

Section 9
Electrical System

Contents

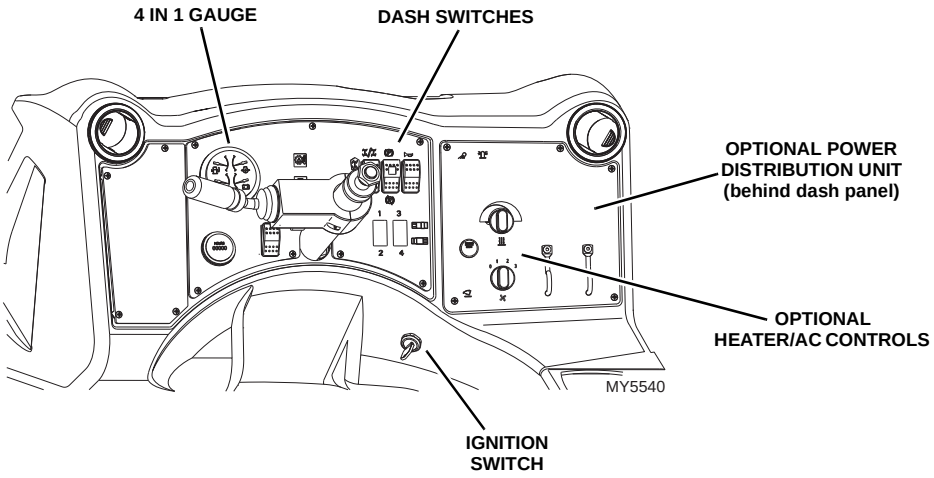
PARAGRAPH		TITLE	PAGE
9.1		**Electrical Component Terminology**	**9-3**
	9.1.1	General Overview - John Deere	9-3
	9.1.2	General Overview - Perkins	9-4
	9.1.3	General Overview - Cummins	9-5
9.2		**Specifications**	**9-6**
9.3		**Safety Information**	**9-6**
9.4		**Fuses and Relays**	**9-6**
	9.4.1	Engine Compartment	9-6
	9.4.2	Cab	9-6
	9.4.3	Power Distribution Unit (VEC) - John Deere/Perkins	9-7
	9.4.4	Power Distribution Unit (VEC) - Cummins	9-8
	9.4.5	Optional Power Distribution Unit (VEC)	9-9
9.5		**Electrical System Schematics**	**9-10**
	9.5.1	Cab Schematic - John Deere	9-10
	9.5.2	Cab Schematic - Perkins	9-11
	9.5.3	Cab Schematic - Cummins	9-12
	9.5.4	Options Schematic - John Deere/Perkins	9-13
	9.5.5	Options - Cummins	9-14
	9.5.6	Chassis Schematic - John Deere	9-15
	9.5.7	Chassis Schematic - Perkins Before S/N 0160037186	9-16
	9.5.8	Chassis Schematic - Perkins S/N 0160037186 Thru 0160039397 Excluding 0160039394 & 0160039397	9-17
	9.5.9	Chassis Schematic - Cummins S/N 0160039451 and After Including 0160039394 & 0160039397	9-18
	9.5.10	Power Unit Schematic - John Deere	9-19
	9.5.11	Power Unit Schematic - Perkins	9-20
	9.5.12	Power Unit Schematic - Cummins	9-21
9.6		**Circuit Breakdowns**	**9-22**
	9.6.1	Constant Power Circuit from Battery - John Deere & Perkins	9-22
	9.6.2	Constant Power Circuit from Battery - Cummins	9-23
	9.6.3	Start & Charge Circuit - John Deere & Perkins	9-24
	9.6.4	Start & Charge Circuit - Cummins	9-25
9.7		**Engine Start Circuit**	**9-26**
	9.7.1	Starter	9-26
	9.7.2	Charging Circuit	9-27
	9.7.3	Alternator	9-27

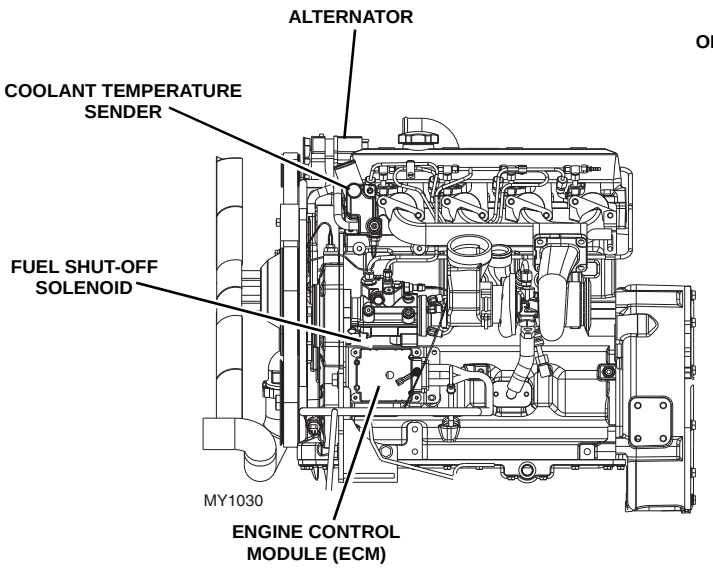
9.8 Window Wiper/Washer Windshield Wiper Motor 9-28
9.8.1 Windshield/Rear Window Washer Reservoir 9-29
9.9 Cab Heater and Fan. 9-30
9.9.1 Cab Heater Controls 9-30
9.10 Solenoids, Sensors and Senders 9-30
9.10.1 Fuel Shut-off Solenoid - John Deere 9-30
9.10.2 Park Brake Solenoid Valve 9-31
9.10.3 Transmission Solenoid Valves 9-32
9.10.4 Transmission Temperature Sender 9-32
9.10.5 Engine Coolant Temperature Sender 9-32
9.10.6 Air Manifold Temperature Sensor - John Deere 9-34
9.10.7 Engine Oil Pressure Sender/Switch 9-34
9.10.8 Fuel Level Sender 9-35
9.10.9 Inclinometer Switch 9-36
9.10.10 Front and Rear Axle Proximity Sensors 9-37
9.11 Display Monitor and Gauges 9-37
9.11.1 Analog Gauges 9-37
9.12 Dash Switches 9-38
9.12.1 Ignition Key Switch 9-38
9.12.2 Dash Switches 9-39
9.13 Troubleshooting - John Deere 9-40
9.13.1 Engine Fault Codes Retrieval 9-40
9.13.2 Engine Fault Codes Chart 9-40
9.14 Engine Indicator Lamps - Perkins 9-42
9.15 SAE Diagnostic Trouble Codes and Fault Codes - Cummins 9-43

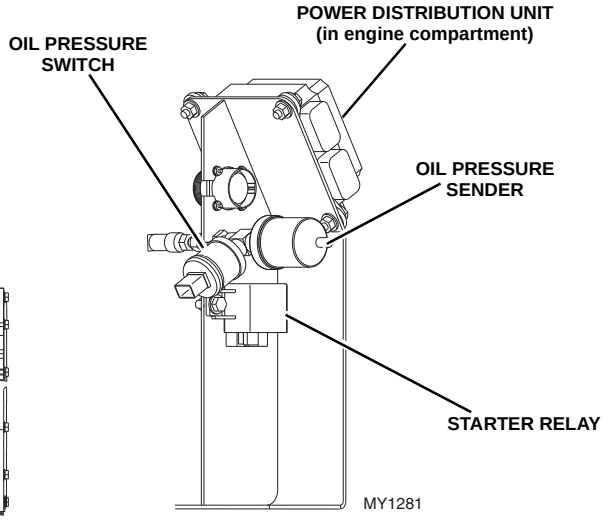
9.1 ELECTRICAL COMPONENT TERMINOLOGY

To understand the safety, operation, and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the electrical components of the machine. The following illustration identifies the components that are referred to throughout this section.

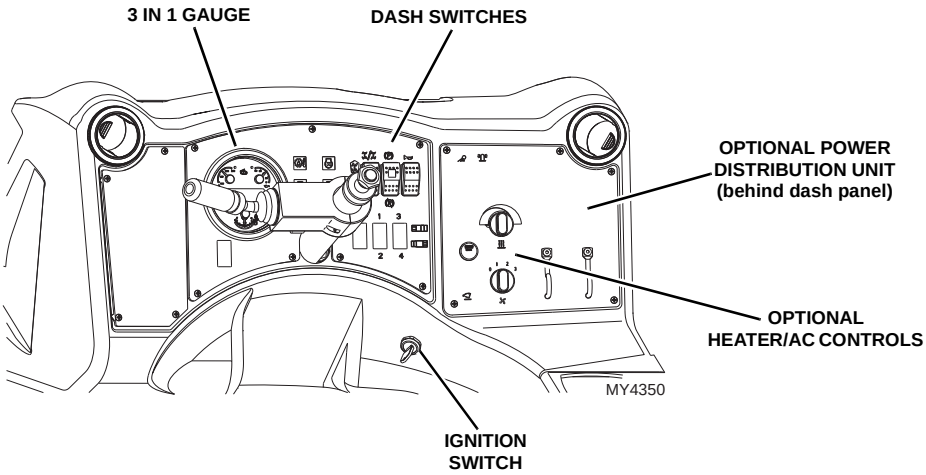
9.1.1 General Overview - John Deere

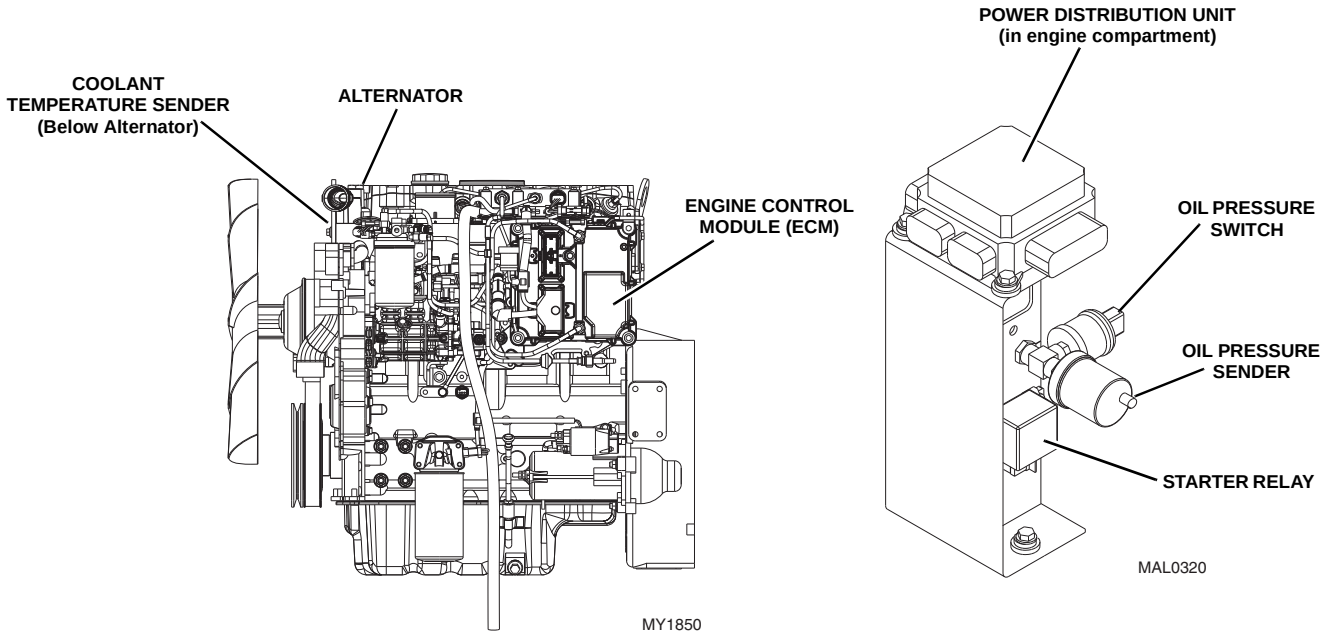




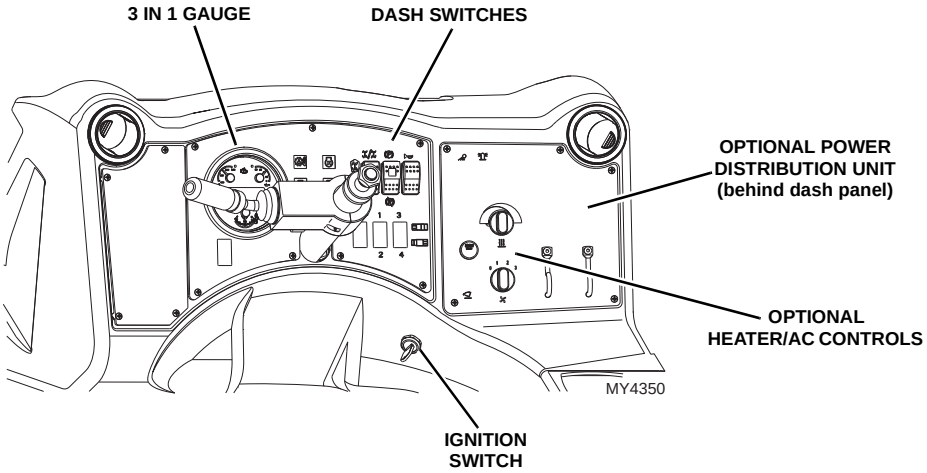


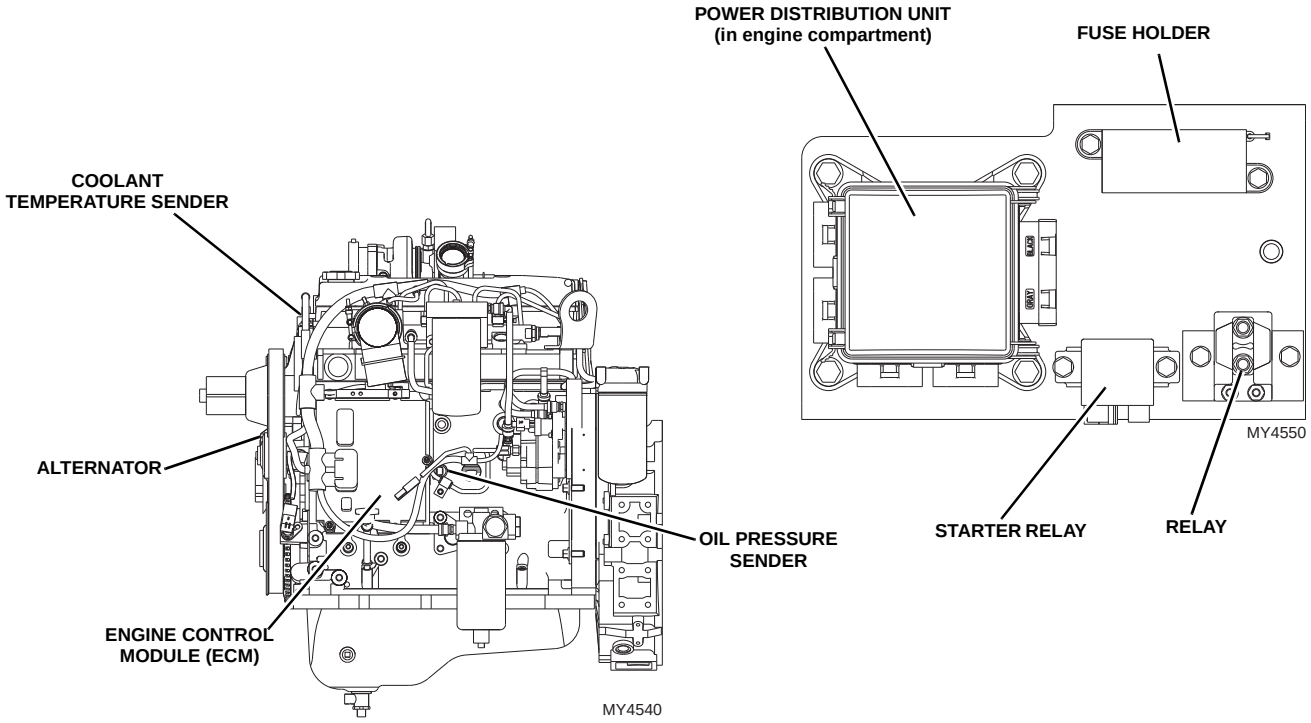
9.1.2 General Overview - Perkins





9.1.3 General Overview - Cummins





9.2 SPECIFICATIONS

Electrical system specifications are listed in Section 2, “General Information and Specifications.”

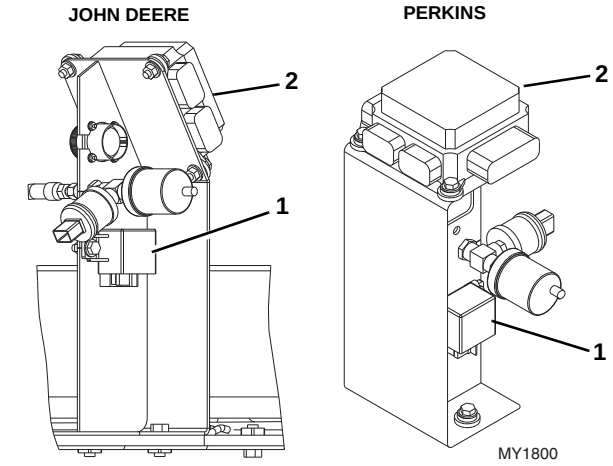
9.3 SAFETY INFORMATION

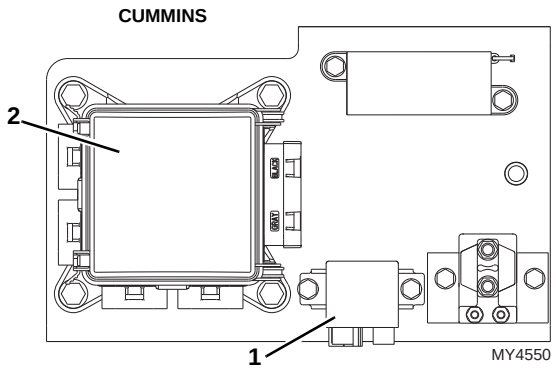
WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual.

9.4 FUSES AND RELAYS

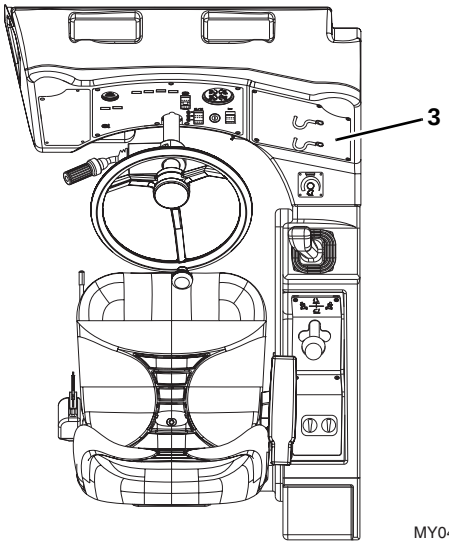
9.4.1 Engine Compartment





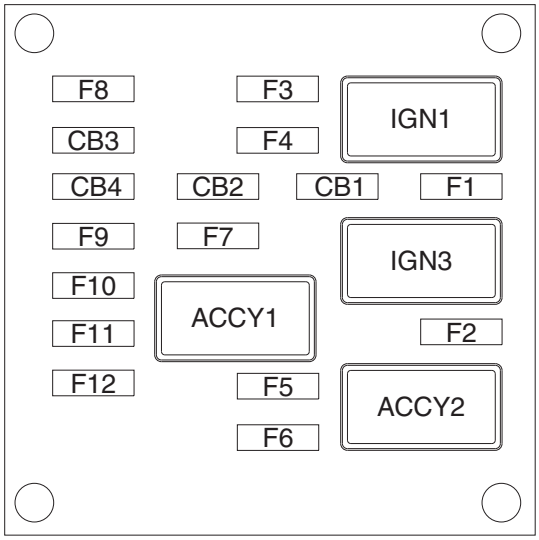
The starter relay (**1**) and power distribution unit (**2**) is located on the power distribution unit bracket in the engine compartment.

9.4.2 Cab



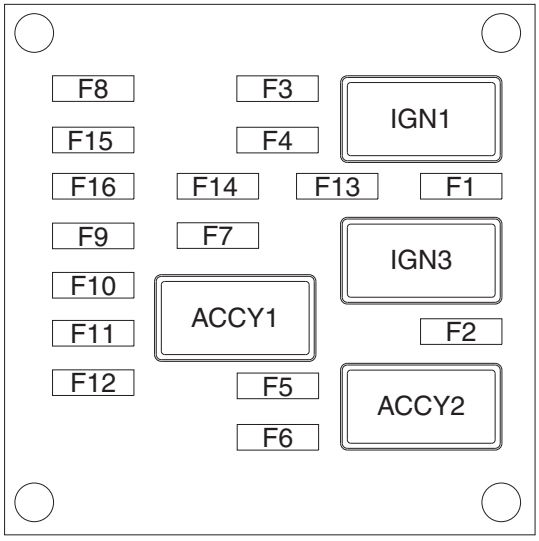
The optional power distribution unit is located in the cab. For access, remove the screws securing the load chart panel (**3**) to the dash.

9.4.3 Power Distribution Unit (VEC) - John Deere/Perkins



Connector Legend		
No.	**Function**	**Amp Rating**
CB1	Options Power 3	20
CB2	Options Power 4	20
CB3	Options Power 1	20
CB4	Options Power 2	20
F1	Trans/Park Brake Power	15
F2	Alternator Excite	5
F3	Engine ECU Ignition Power	10
F4	Gauge Power	10
F5	Spare Accessory Power	15
F6	Auxiliary Electric Power	10
F7	Horn Power	15
F8	Spare Battery Power	25
F9	Engine ECU Battery Power	25
F10	Steer/Sway Power	10
F11	Rear Axle Stabilizer/Tilt Power	10
F12	Key Battery Power	15
IGN1	Ignition 1	
IGN 2	Ignition 2	
ACCY1	Accessory 1	
ACCY2	Accessory 2	

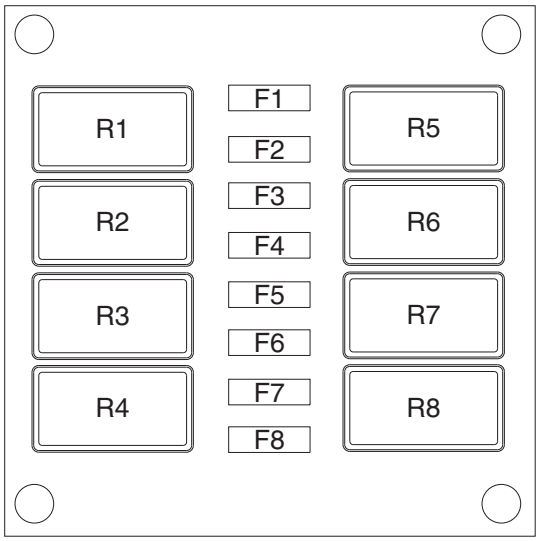
9.4.4 Power Distribution Unit (VEC) - Cummins



MY4610

Connector Legend		
No.	**Function**	**Amp Rating**
F1	Trans/Park Brake Power	15
F2	Alternator Excite	5
F3	Engine ECU Ignition Power	10
F4	Gauge Power	10
F5	Spare Accessory Power	15
F6	Auxiliary Electric Power	10
F7	Horn Power	15
F8	Spare Battery Power	25
F9	Engine ECU Battery Power	25
F10	Steer/Sway Power	10
F11	Rear Axle Stabilizer/Tilt Power	10
F12	Key Battery Power	15
F13	Options Power 3	20
F14	Options Power 4	20
F15	Options Power 1	20
F16	Options Power 2	20
IGN1	Ignition 1	
IGN 2	Ignition 2	
ACCY1	Accessory 1	
ACCY2	Accessory 2	

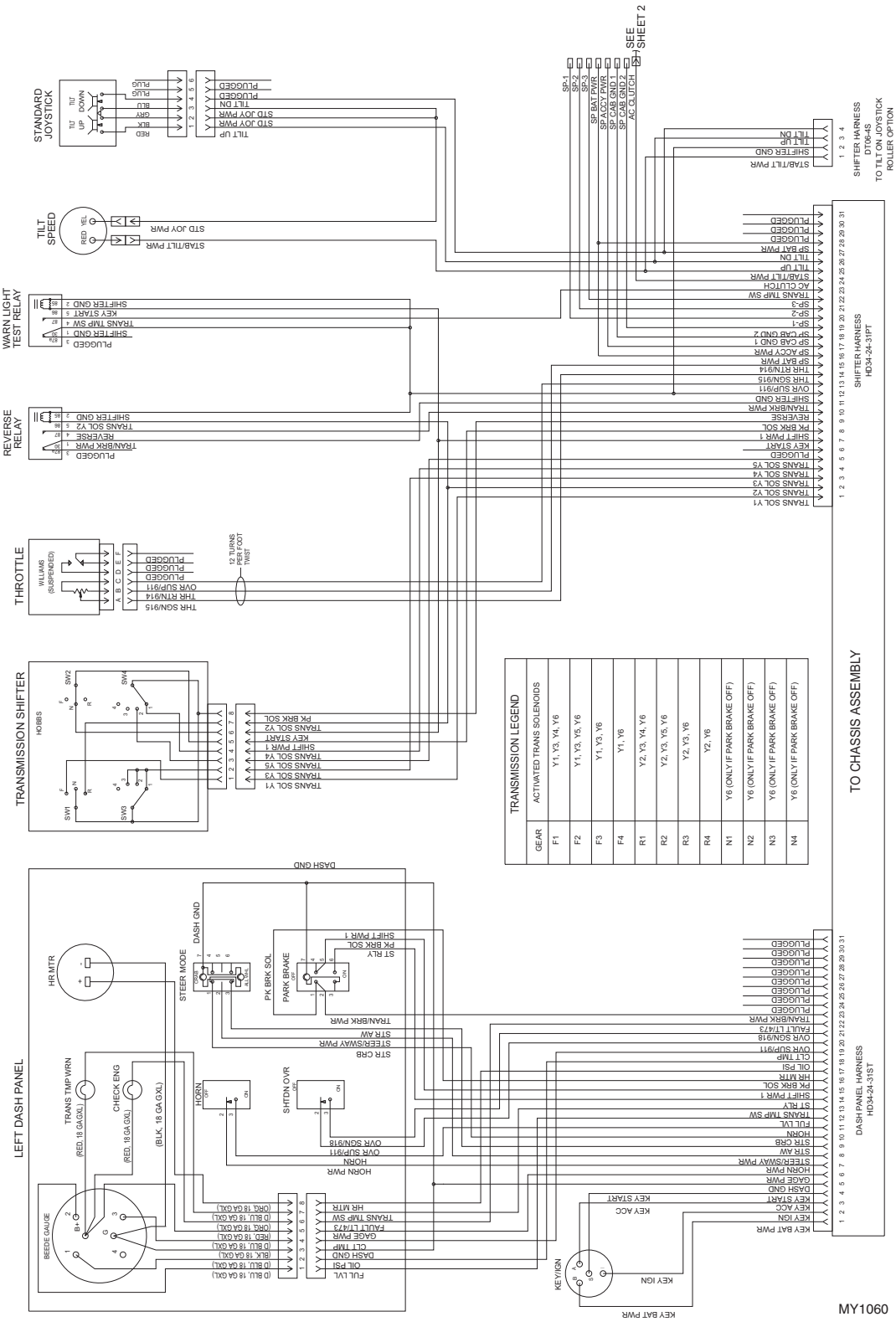
9.4.5 Optional Power Distribution Unit (VEC)



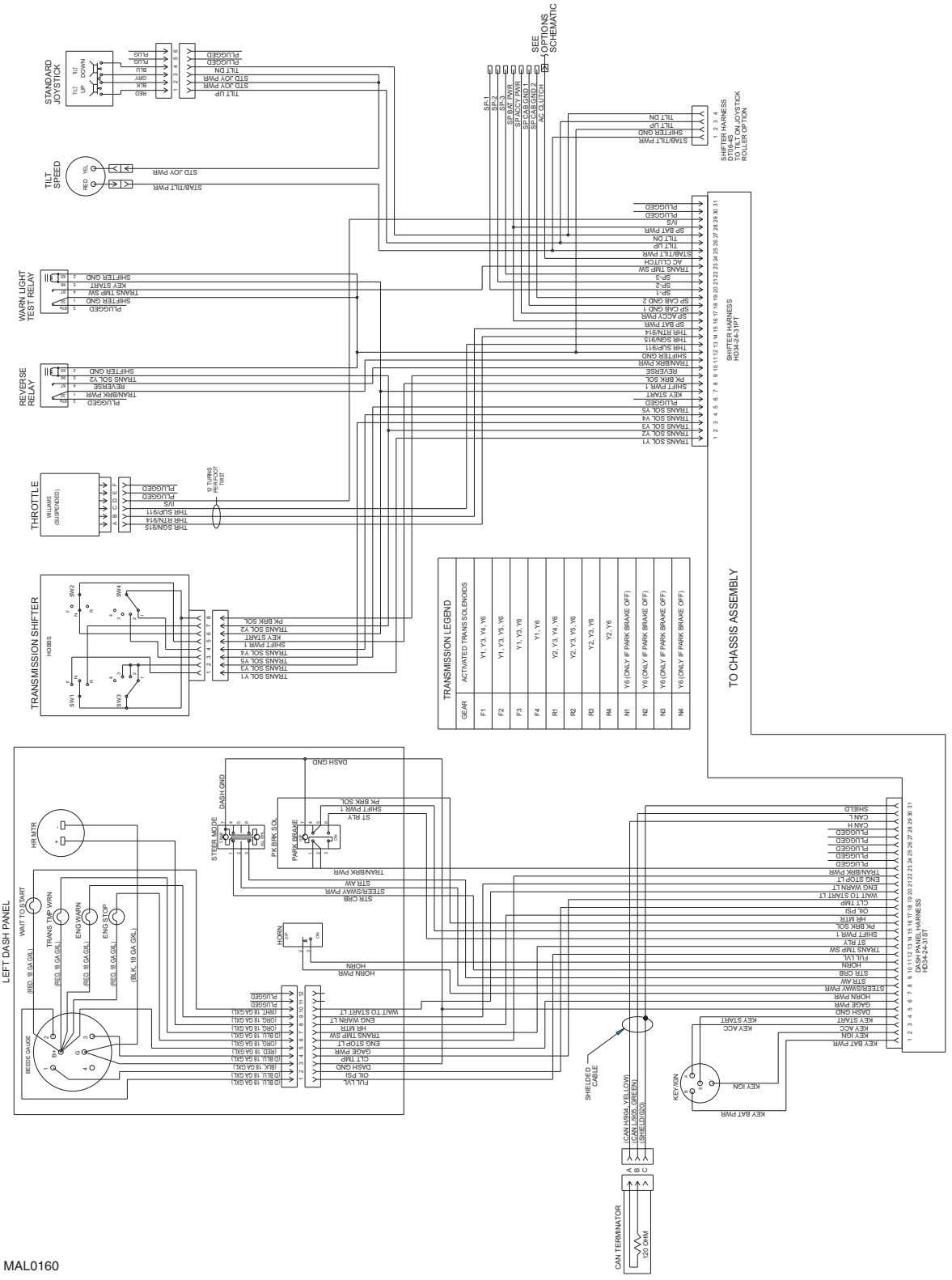
Connector Legend		
No.	**Function**	**Amp Rating**
F1	Wiper	20
F2	Option (Roof Wiper)	5
F3	Option	15
F4	Option	25
F5	Heater	20
F6	Lights	20
F7	Beacon	10
F8	Dash Fan	10
R1	Wiper	
R2	Heater Blower	
R3	Aux Elec 1	
R4	Aux Elec 2	
R5	Option	15
R6	Option	25
R7	Lights	
R8	Beacon/Fan	

9.5 ELECTRICAL SYSTEM SCHEMATICS

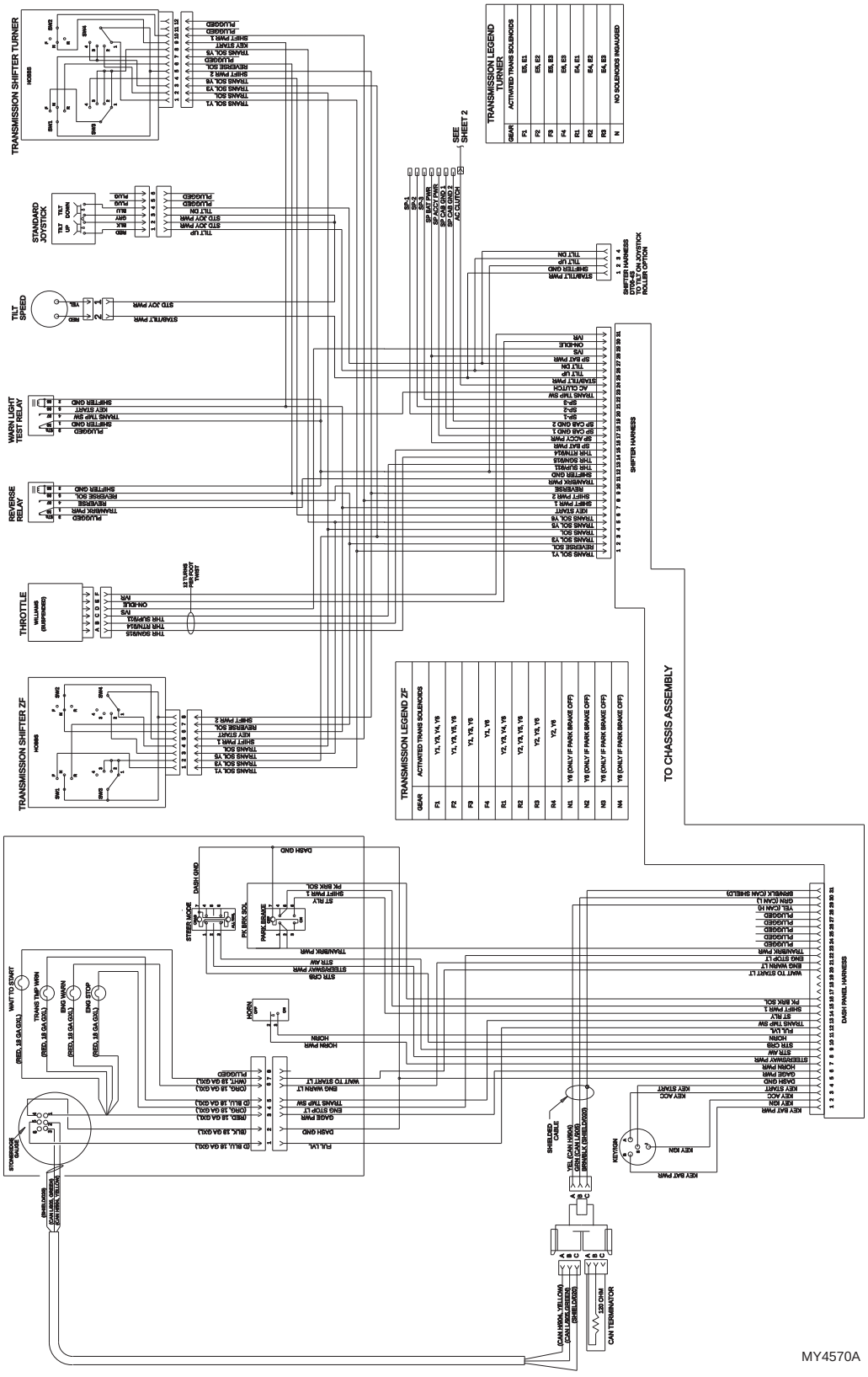
9.5.1 Cab Schematic - John Deere



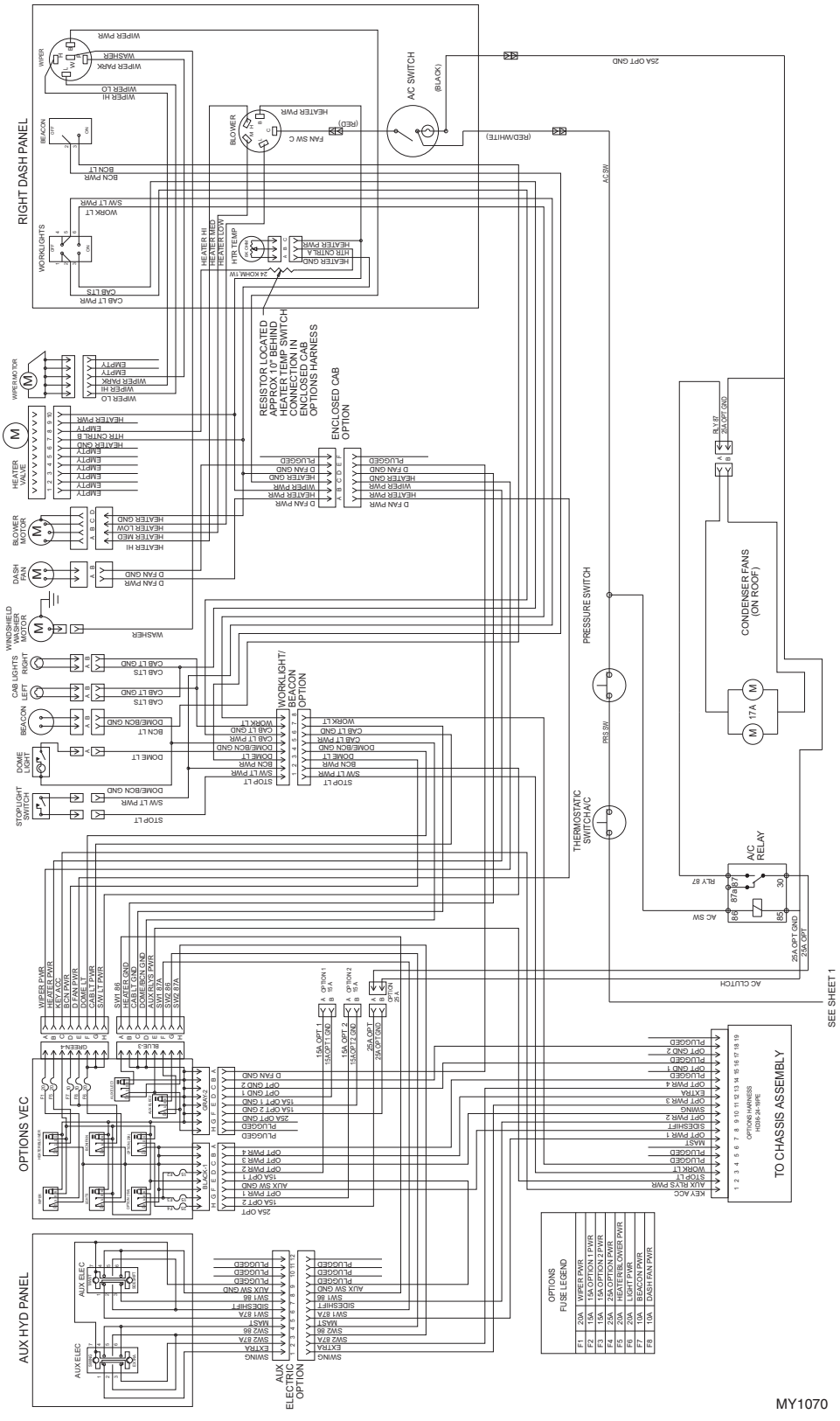
9.5.2 Cab Schematic - Perkins



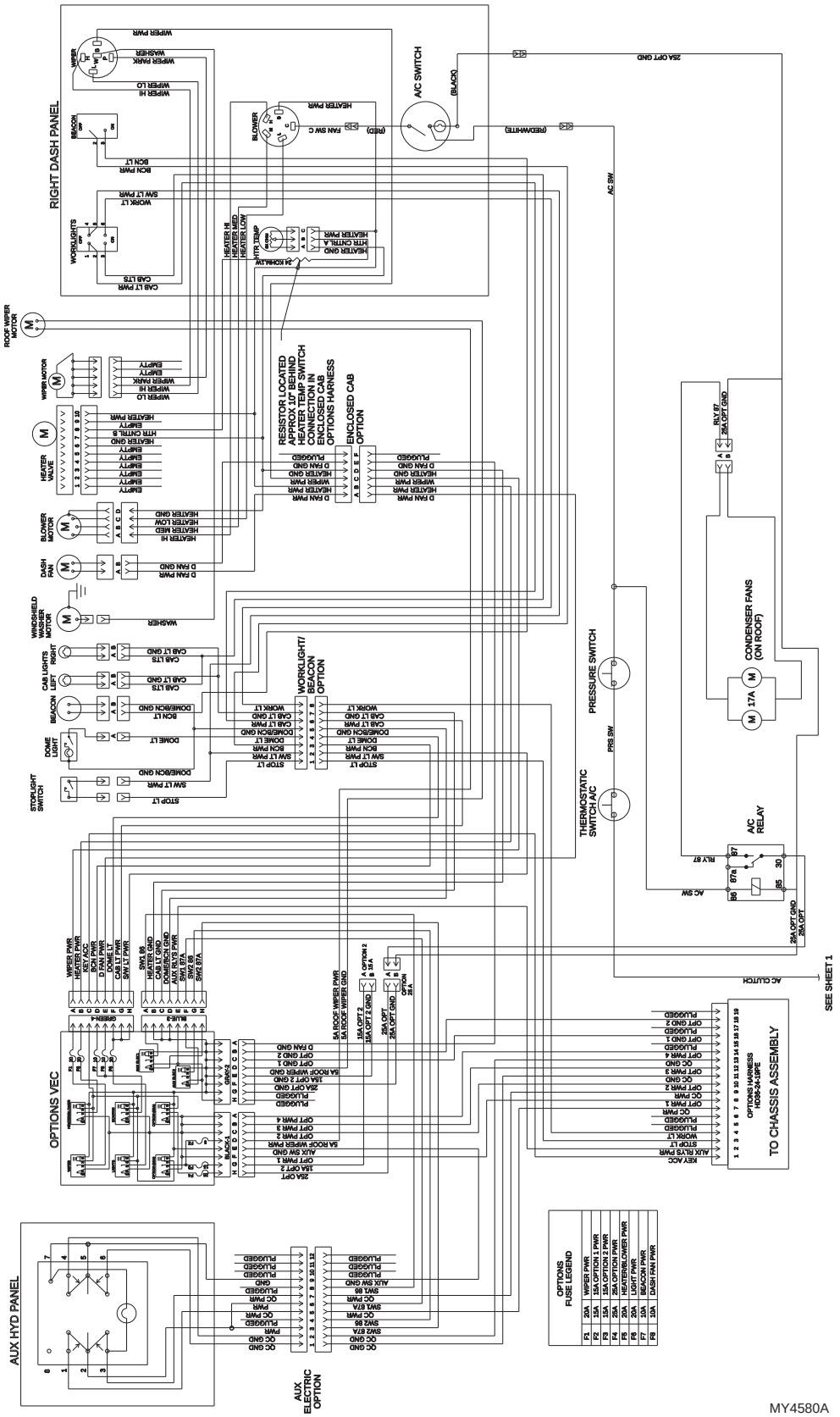
9.5.3 Cab Schematic - Cummins



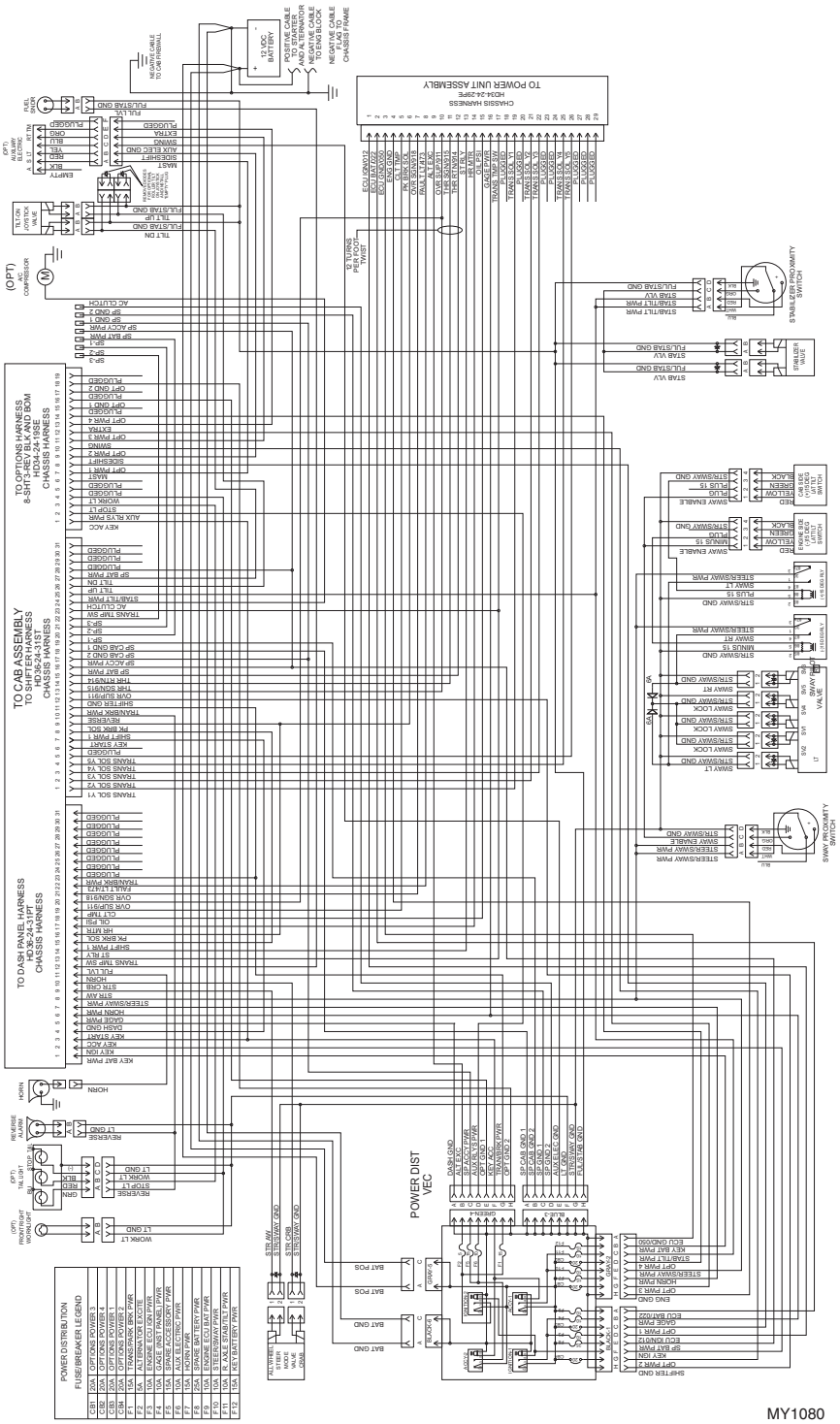
9.5.4 Options Schematic - John Deere/Perkins



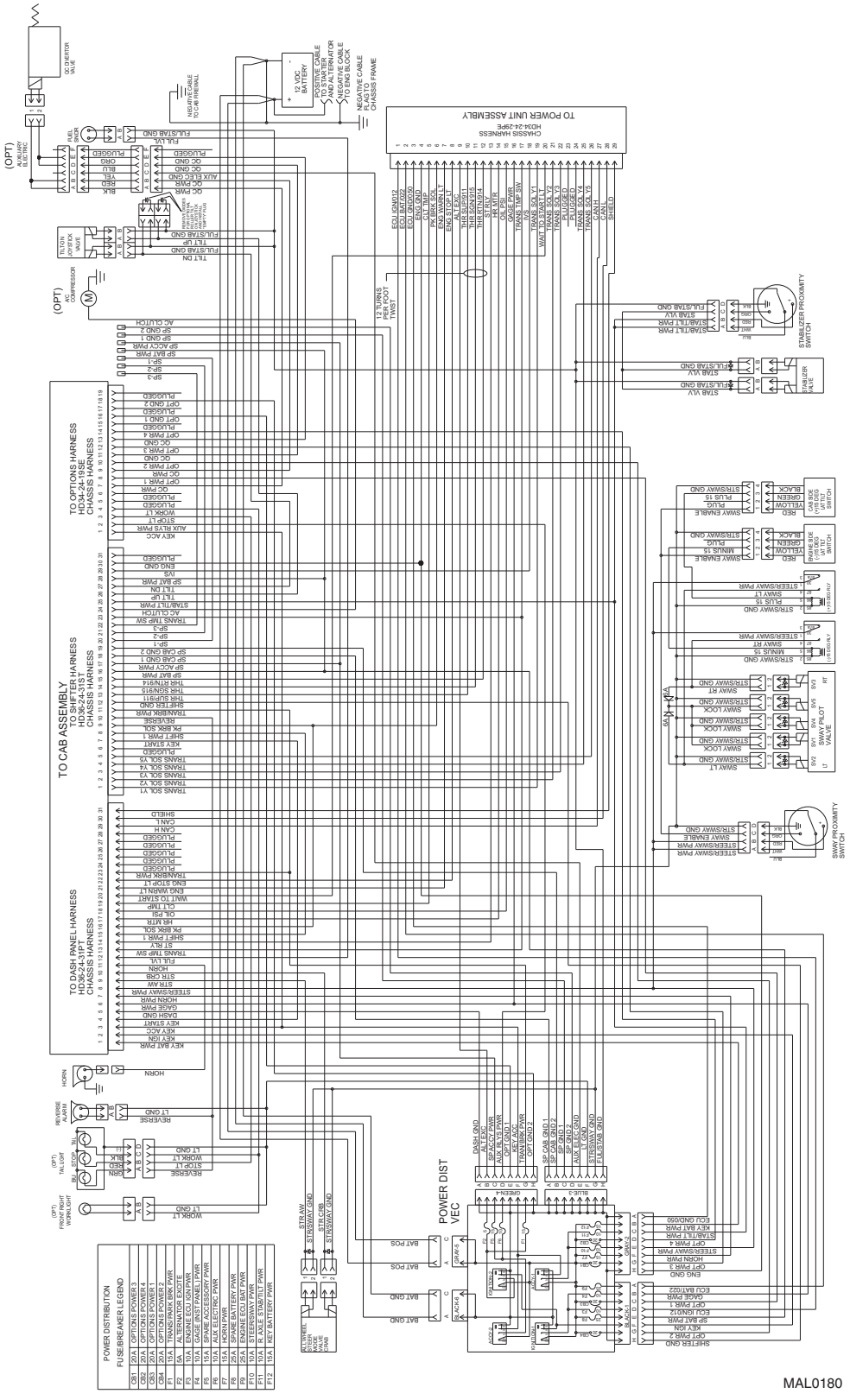
9.5.5 Options - Cummins



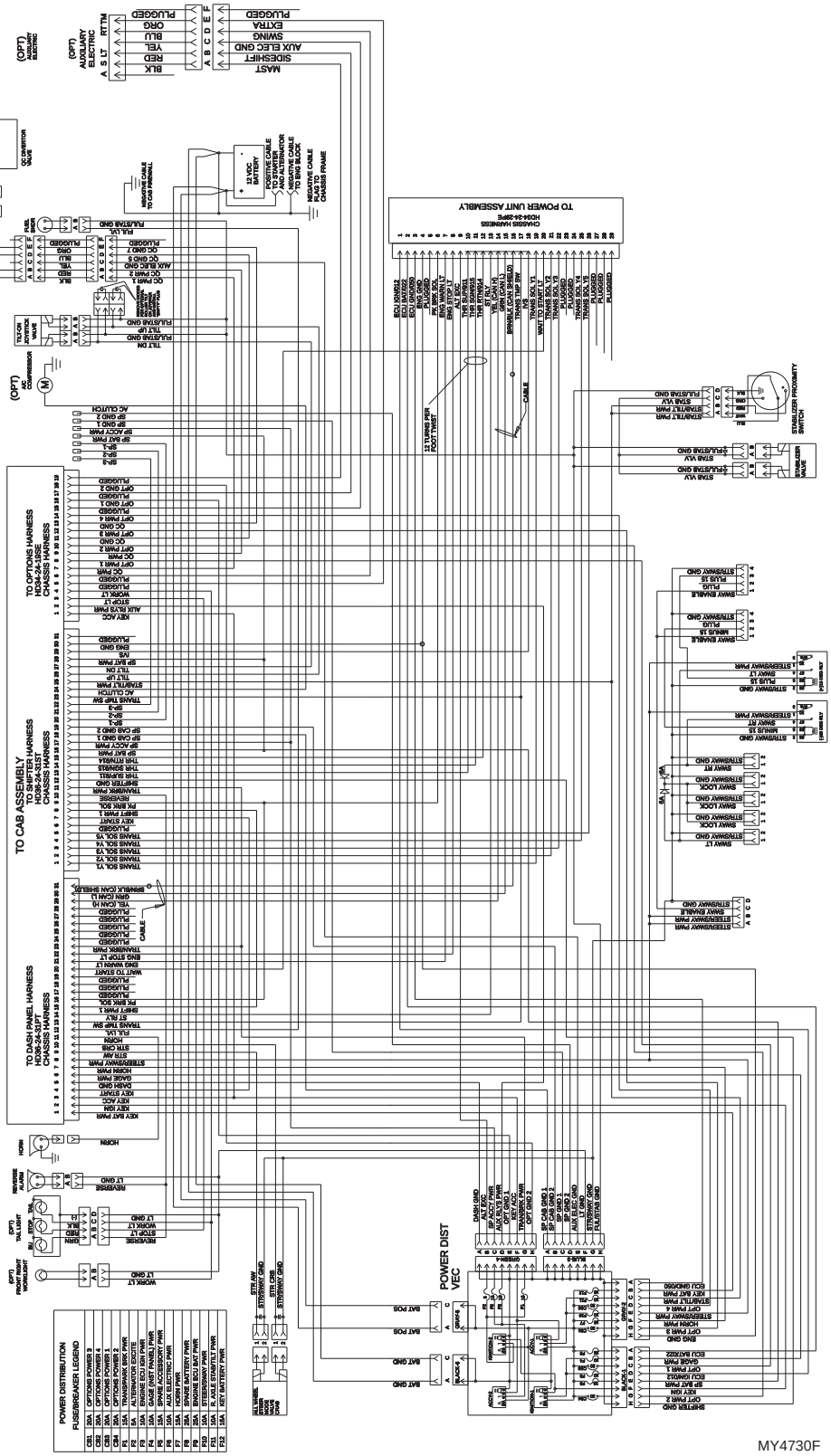
9.5.6 Chassis Schematic - John Deere



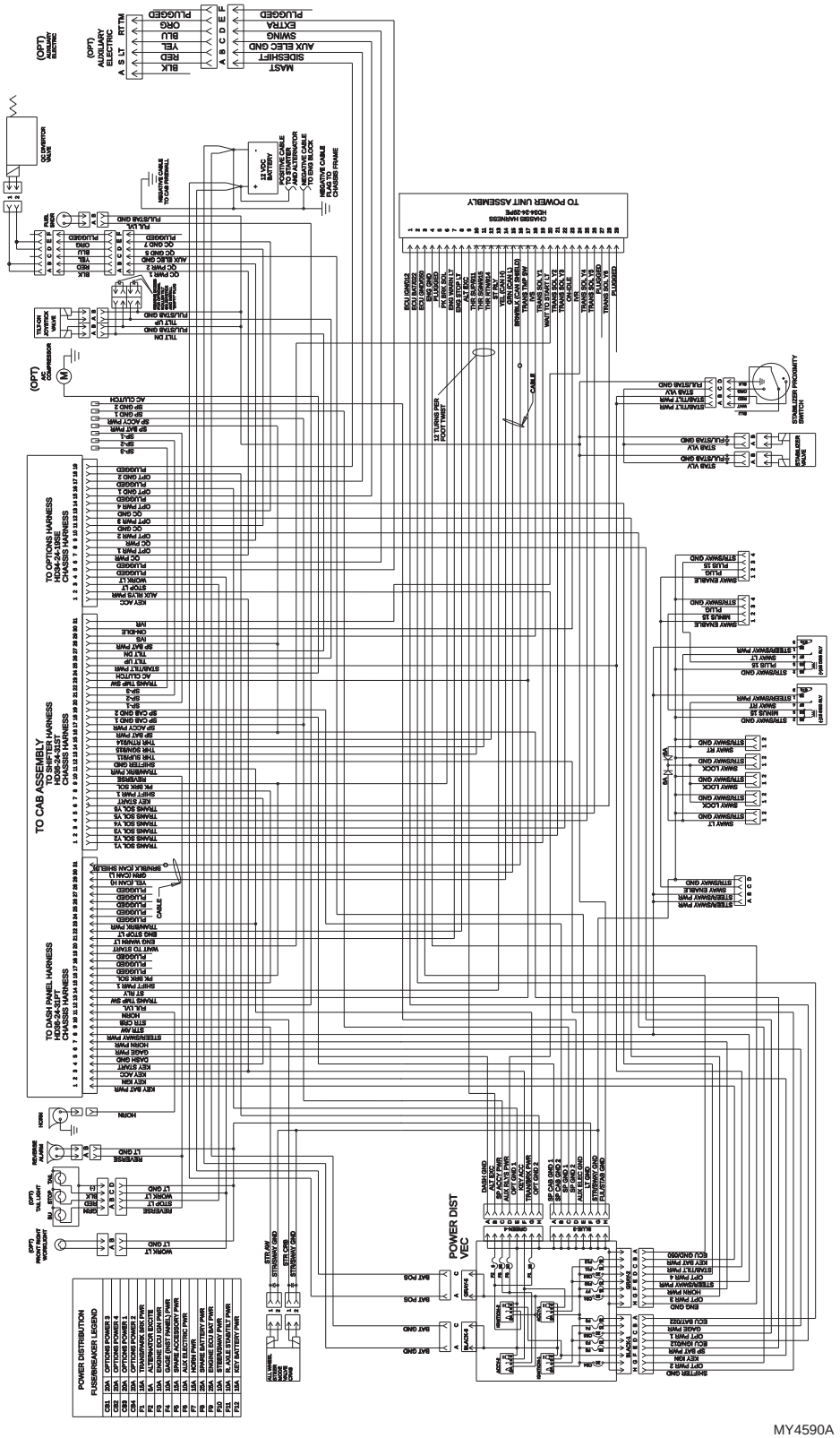
9.5.7 Chassis Schematic - Perkins Before S/N 0160037186



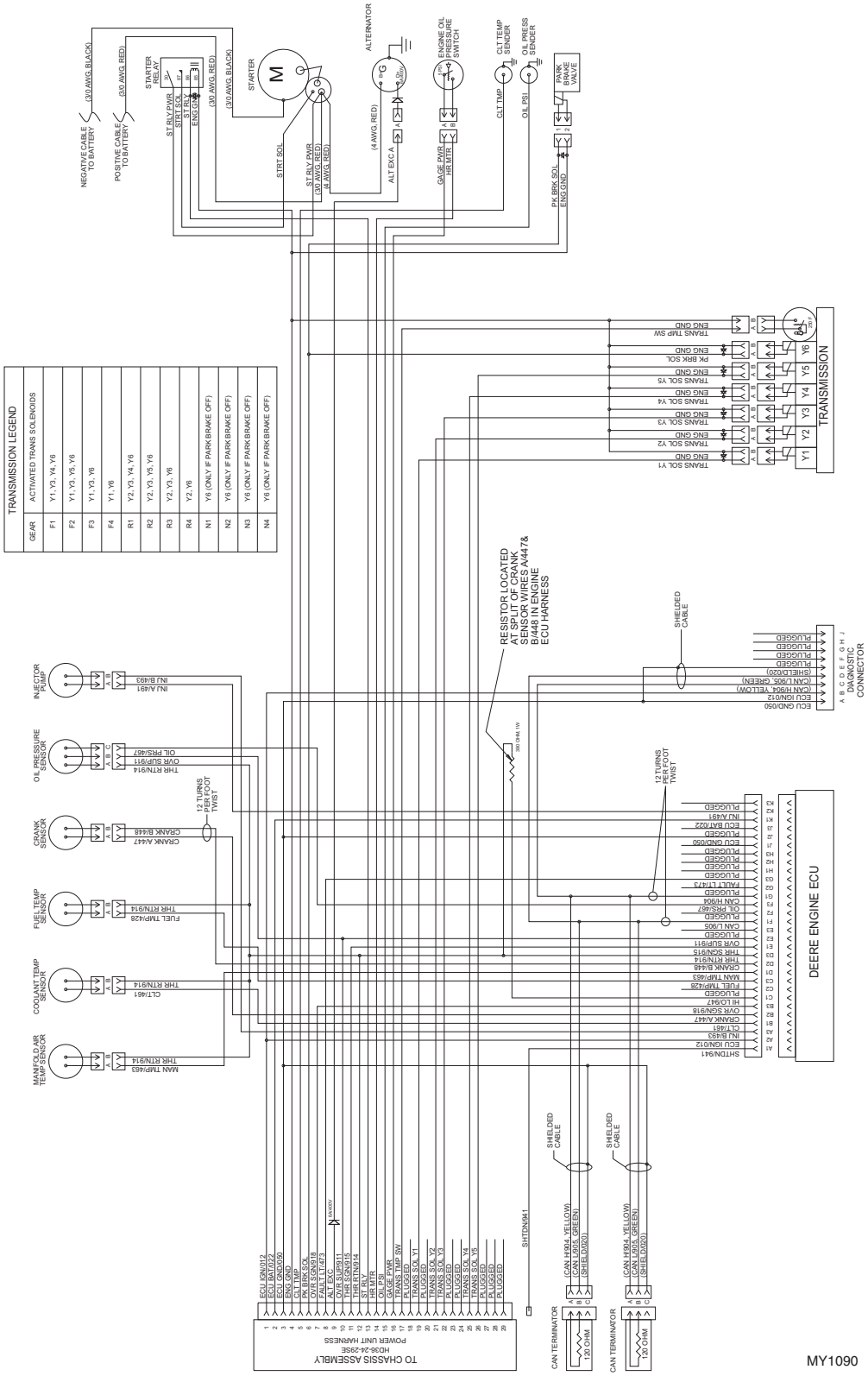
9.5.8 Chassis Schematic - Perkins
S/N 0160037186 Thru 0160039397 Excluding 0160039394 & 0160039397



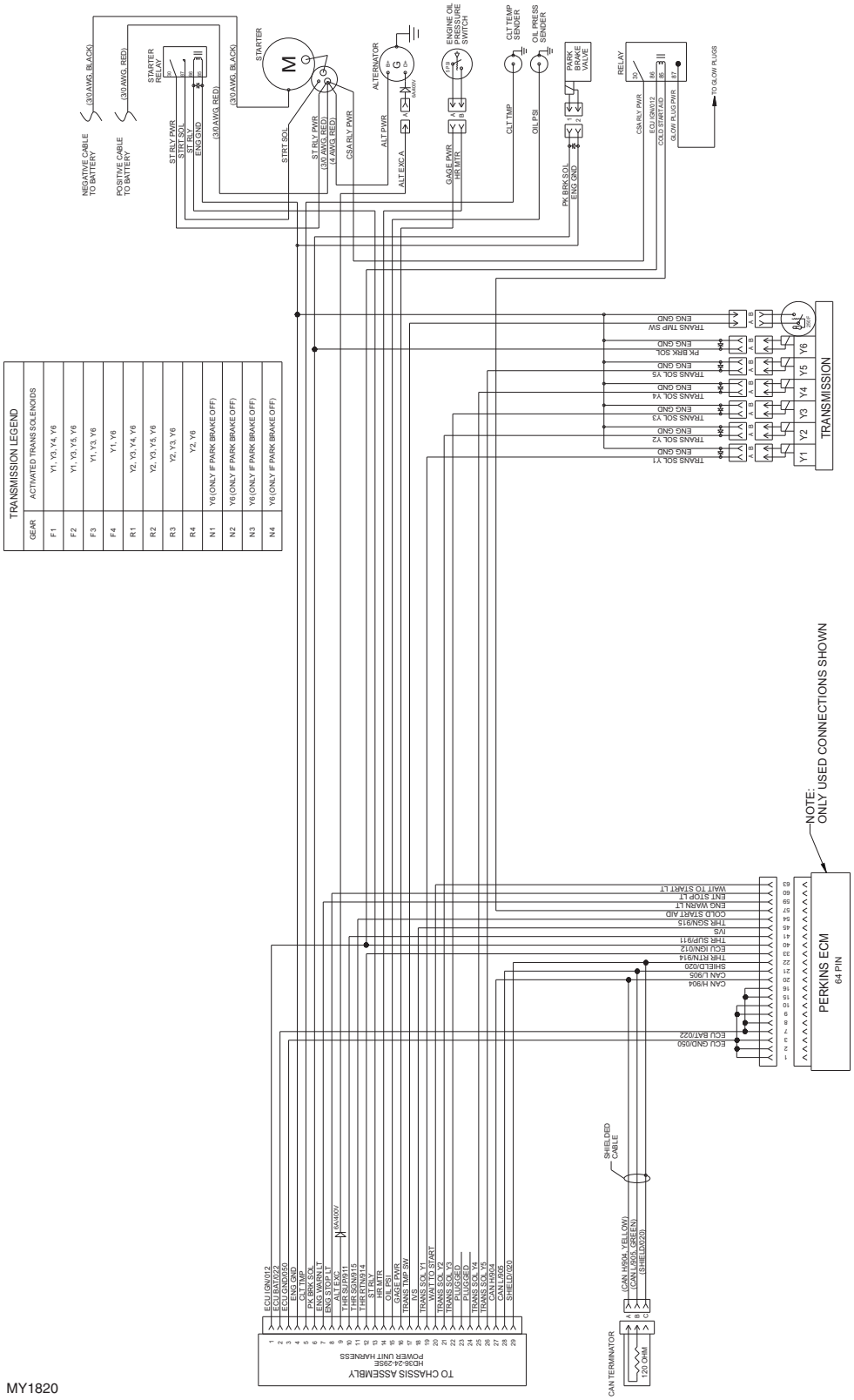
9.5.9 Chassis Schematic - Cummins S/N 0160039451 and After Including 0160039394 & 0160039397



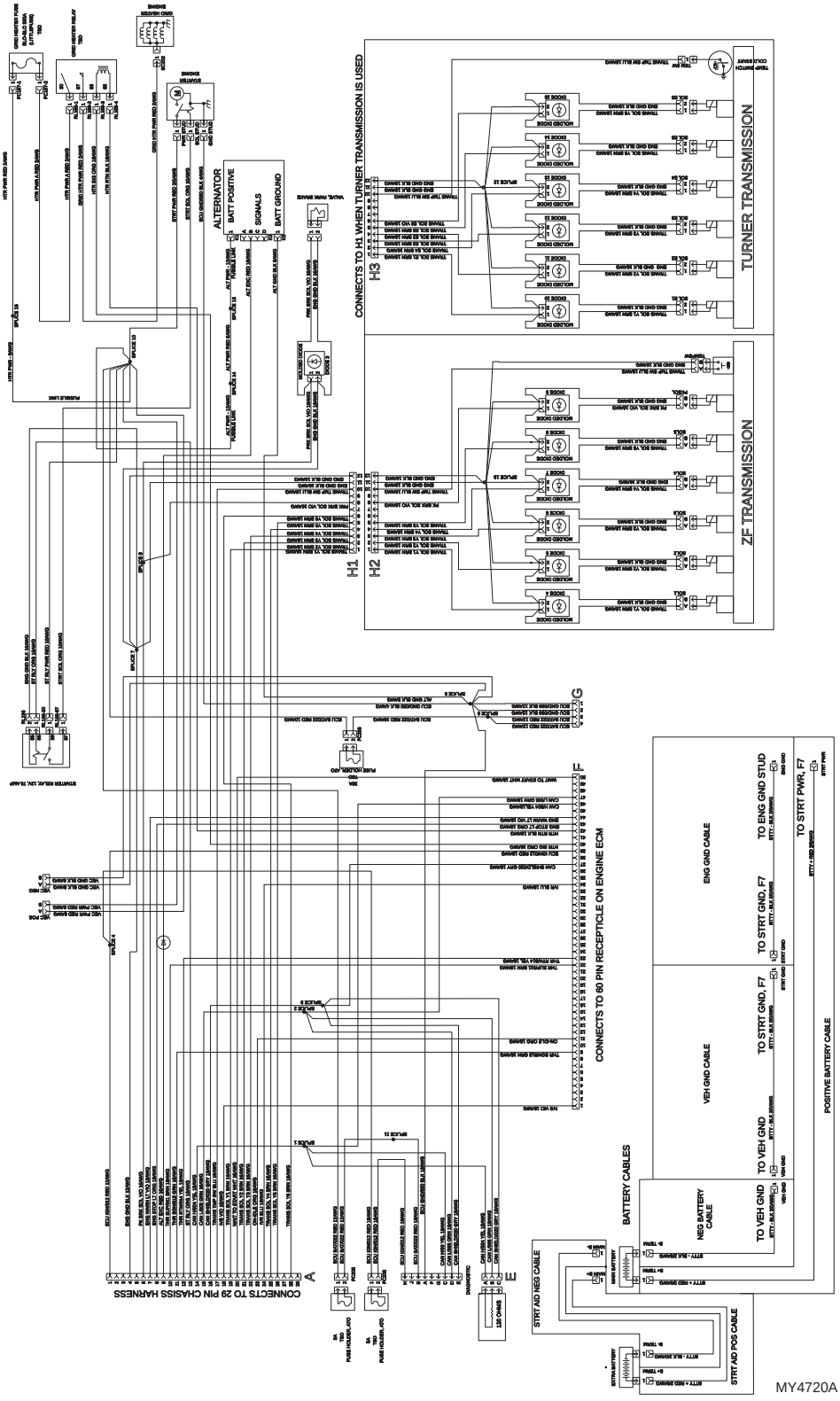
9.5.10 Power Unit Schematic - John Deere



9.5.11 Power Unit Schematic - Perkins

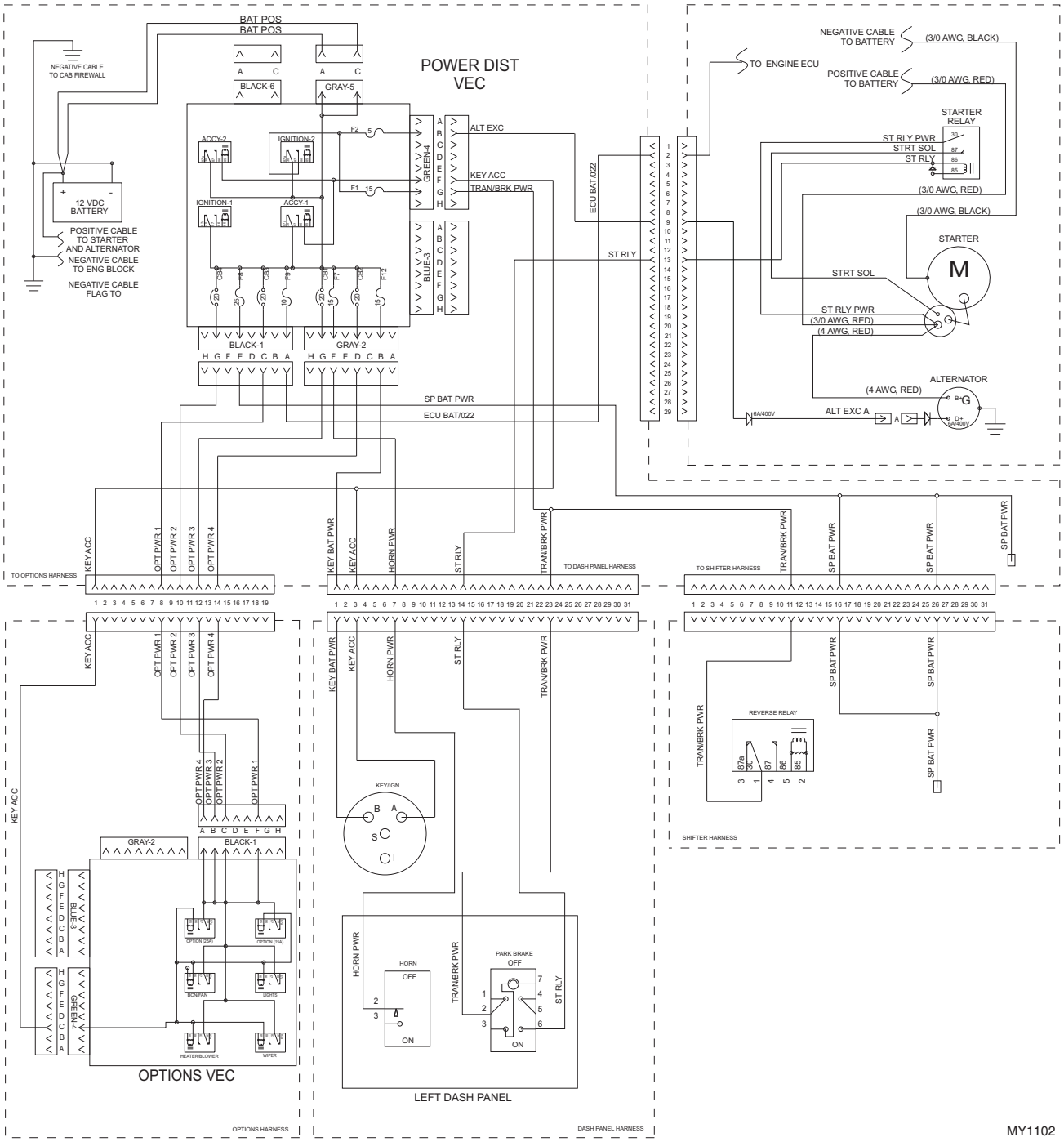


9.5.12 Power Unit Schematic - Cummins

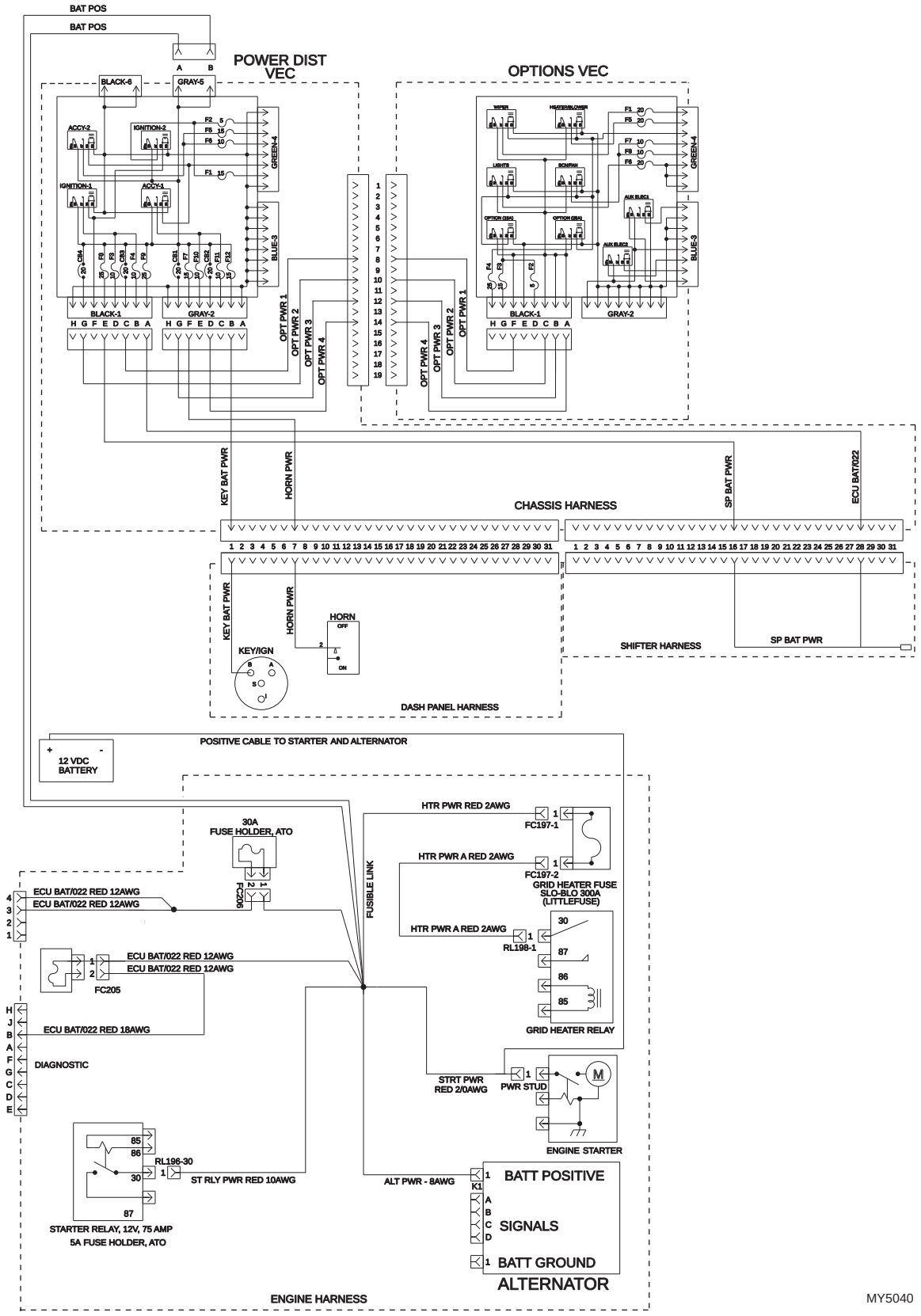


9.6 CIRCUIT BREAKDOWNS

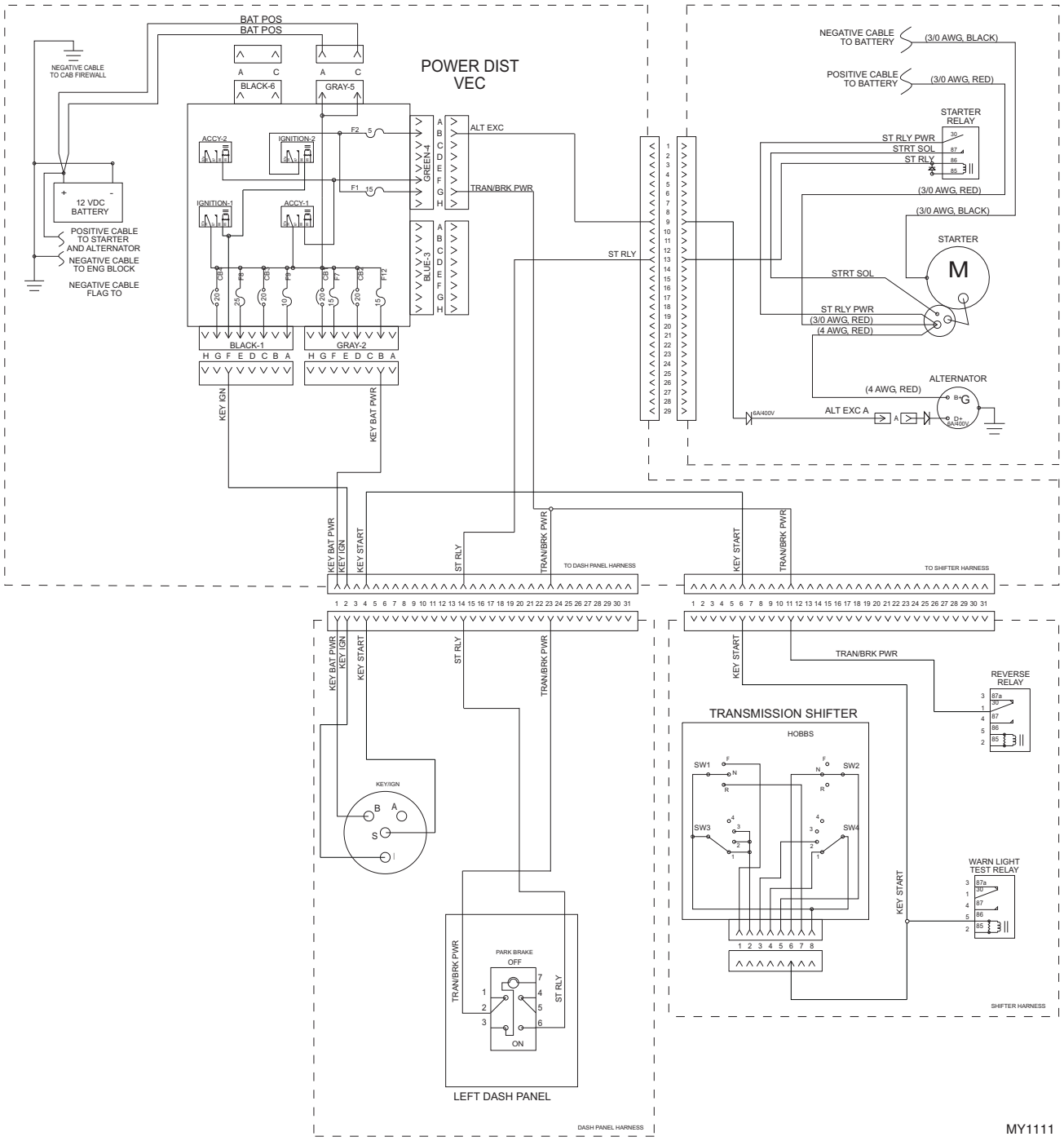
9.6.1 Constant Power Circuit from Battery - John Deere & Perkins



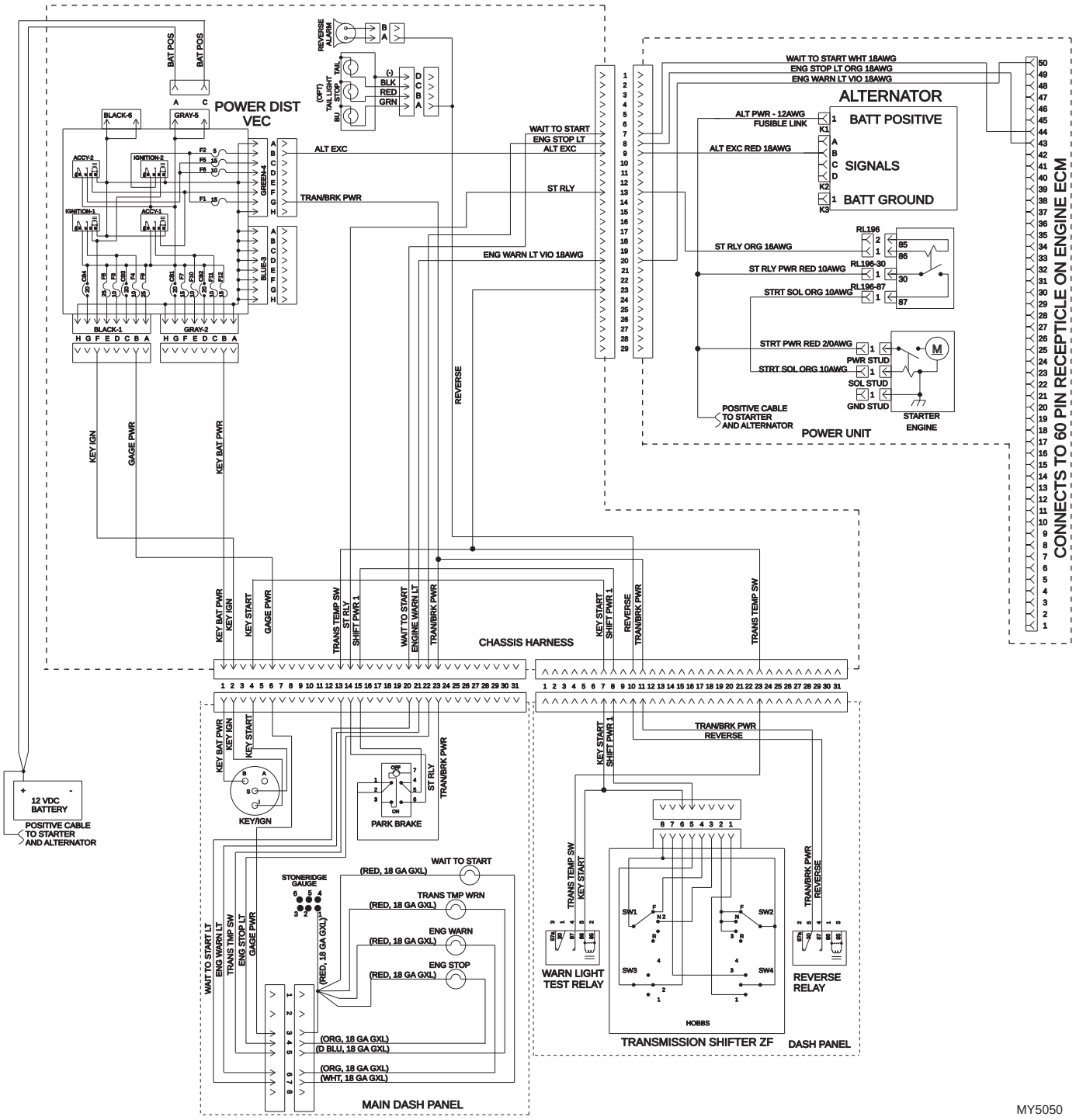
9.6.2 Constant Power Circuit from Battery - Cummins



9.6.3 Start & Charge Circuit - John Deere & Perkins



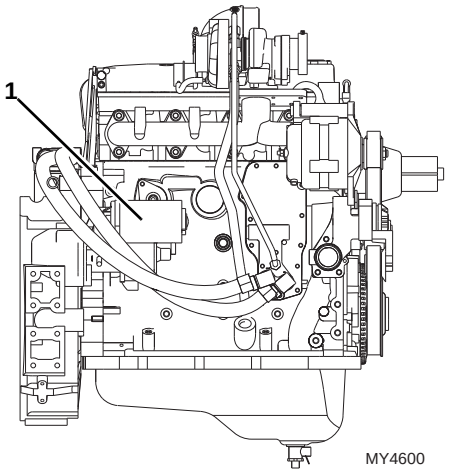
9.6.4 Start & Charge Circuit - Cummins



MY5050

9.7 ENGINE START CIRCUIT

9.7.1 Starter



The starter (**1**) is located on the left side of the engine (the right side of the machine - John Deere).

The starter (**1**) is located on the right side of the engine (the right side of the machine - Perkins & Cummins).

a. Testing the Starter on the Engine

If the starter does not engage when the ignition key switch is turned, check the following:

1. The main fuse may be blown, requiring replacement. Check for the cause of the blown fuse.
2. There may be a defect in the ignition key switch, ignition wiring or starter solenoid.
3. Check battery condition. Clean the battery posts and the connectors at each end of the battery cables.
4. Check for broken wiring and damaged insulation on the wiring. Replace all broken or damaged wiring.
5. Check all connections at the starter solenoid, key switch and wiring harness plugs. Clean and tighten all connections.
6. If the starter still does not operate after these checks have been performed, check the starting circuit.

b. Starter Circuit Checks

1. Check wires and connections for looseness, corrosion, damage, etc.
2. If a “whirring” noise is heard but the engine does not turn over, the starter is spinning but not engaging the flywheel. The starter drive or solenoid that pushes the drive forward to engage the flywheel may be defective. Missing or damaged teeth on the flywheel can also prevent the starter from cranking the engine.
3. If the starter only “clicks” it may indicate that the battery is discharged, or that there is a loose or corroded battery cable connection. Check the battery state of charge and battery condition first, then check the cables and cable connections.
4. For additional information on the starting circuit, refer to Section 9.5, “Electrical System Schematics.”

c. Starter Removal

Remove the starter only if it fails. To remove the starter:

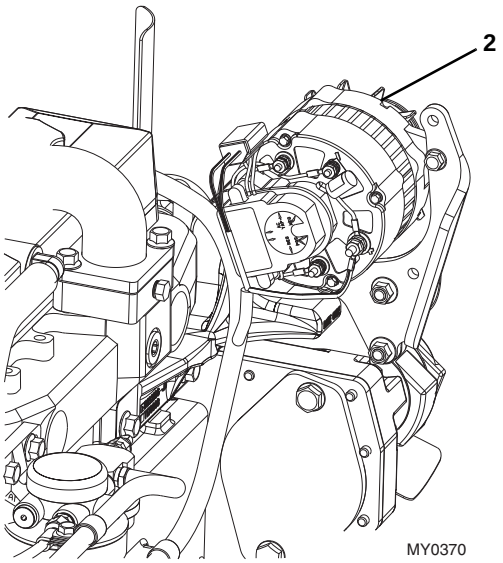
1. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
2. Open the engine cover.
3. Properly disconnect the battery.
4. Remove the wires from the solenoid stud. Remove the positive (+) battery cable from the starter. Label and disconnect the wire from the starter solenoid housing stud. Record how the wires are installed to ensure correct installation later.
5. Loosen, but **DO NOT** remove, the three fasteners securing the starter to the flywheel housing. Support the starter securely, as it is relatively heavy and will fall if not supported.
6. Support the starter and remove the fasteners securing the starter to the engine. Remove the negative (-) ground cable from its starter mounting bolt.
7. Remove the starter from the machine.

d. Starter Installation

1. Position the starter in its mounting opening on the flywheel housing. Position the ground cable over the correct starter mounting bolt. Secure the starter with the three fasteners.
2. Connect the positive (+) battery cable to the upper solenoid stud. Install the wires to the upper solenoid stud, and secure with lock washer and nut.
3. Connect the wire to the solenoid mounting stud.
4. Properly connect the battery.
5. Close and secure the engine cover.

6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.7.2 Charging Circuit



Before using a battery charger, an attempt can be made to recharge the battery by jump-starting the machine (Refer to the appropriate Operation & Safety Manual). Allow the engine to run, which will enable the alternator (**2**) to charge the battery.

If the engine alternator charging warning indicator illuminates, perform the following checks:

1. Check all battery cable connections at the battery, and verify that they are clean and tight.
2. Check the external alternator wiring and connections, and verify that they are in good condition.
3. Check the fan belt condition and tension.
4. Run the engine and check the alternator for noise. A loose drive pulley, loose mounting hardware, worn or dirty internal alternator bearings, a defective stator or defective diodes can cause noise. Replace a worn or defective alternator.

9.7.3 Alternator

a. Alternator Removal

1. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
2. Open the engine cover. Allow the system fluids to cool.
3. Properly disconnect the battery.
4. Install a drive ratchet into the square hole in the serpentine belt tensioner bracket.
5. While lifting the automatic belt tensioner away from the belt, remove the fan serpentine belt.

Note: *Record how the alternator is installed to ensure correct installation later.*

6. Label and disconnect the wire leads attached to the alternator.
7. Remove the lower mounting capscrew securing the alternator to the lower mounting hole on the engine.
8. While supporting the alternator with one hand, remove the upper (longer) mounting hardware from the upper alternator mount. Remove the alternator from the machine.

b. Alternator Installation

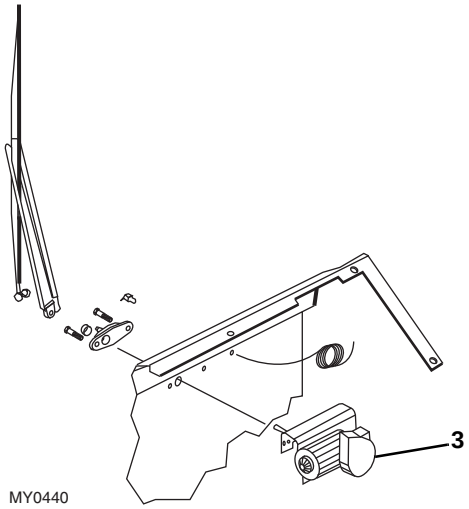
1. Position the alternator and align with the upper alternator mount on the engine bracket. Insert the upper (longer) mounting hardware through the alternator mount. Thread the longer capscrew into the alternator front mount. **DO NOT** tighten completely at this time.
2. Align the lower alternator mount hole with the lower mounting bracket on the engine, and insert the lower mounting capscrew. Tighten the lower capscrew and upper capscrew securely.
3. Place a drive ratchet into the square hole on the serpentine belt tensioner bracket. Apply pressure against the tensioner bracket and route the serpentine belt onto the alternator and engine pulleys. Release and check the tensioner pulley to verify that it is pivoting freely in order to provide the proper tension on the belt. Check for proper belt alignment. (Refer to the appropriate Operation & Safety Manual.)
4. Connect the previously labeled wire leads to the alternator.
5. Properly connect the battery.
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.8 WINDOW WIPER/WASHER WINDSHIELD WIPER MOTOR

a. Removal

Note: *It may be necessary to remove several hydraulic hoses from behind the dash in order to remove and install the wiper motor housing. (Refer to Section 4.3.1, "Steering Column and Orbitrol Valve.")*

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Remove the screws that secure the main dash panel. Pull out the dash panel to gain access to the wiper motor (**3**).
6. Disconnect the cab harness connectors from the wiper motor.
7. Remove the linkage attached to the wiper motor.
8. Loosen and remove the four bolts holding the wiper motor to the mounting bracket.

Note: *Retain all hardware removed from the wiper assembly for possible reuse on the replacement motor housing.*

9. Remove the motor from the inside of the cab.

b. Disassembly

DO NOT disassemble the motor. The motor is not serviceable. Replace motor if found to be defective.

c. Inspection and Replacement

Inspect the motor terminals for continuity. Replace motor if continuity is not found.

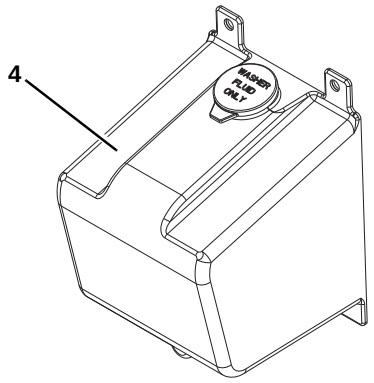
d. Installation and Testing

1. Install all required hardware to the motor assembly.
2. Align motor with the mounting holes and bolt the motor to the mounting bracket.
3. Connect the wiper linkage to the wiper motor shaft.

Note: *Align the wiper linkage arm with the flat on the motor shaft to ensure wiper stroke covers window area, and it does not swipe past the glass area.*

4. Connect the cab harness connectors to windshield wiper motor connectors.
5. Replace the main dash panel to its original orientation. Secure with the previously used screws.
6. Properly connect the battery.
7. Turn ignition key switch to the RUN position, and operate windshield wiper in both LOW and HIGH speeds to ensure proper operation and that correct wiper travel is achieved.
8. If previously removed, install hydraulic hoses under the dash. (Refer to Section 4.3.1, "Steering Column and Orbitrol Valve.")
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.8.1 Windshield/Rear Window Washer Reservoir



The windshield washer motor and reservoir (**4**) is located in the cab behind the seat. It is labeled as a unit and cannot be serviced separately.

a. Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the nuts and the lock washers from the washer mounting bolts.
6. Pull the washer reservoir out and away from the mounting bracket.
7. Rotate the washer reservoir, label and remove the cab harness connectors from the washer reservoir connectors.
8. Remove the windshield washer hoses from the reservoir.

b. Disassembly

DO NOT disassemble the pump. The pump is not serviceable. Replace pump if found to be defective.

c. Installation and Testing

1. Connect the windshield washer hoses to the reservoir.
2. Connect the cab wiring harness connectors to the reservoir connectors.
3. Install the reservoir tank onto the mounting bracket.
4. Install the lock washers and nuts and secure.
5. Fill the washer fluid reservoir with washer fluid.
6. Properly connect the battery.
7. Turn the ignition key switch to the RUN position and press the washer switch. Verify that fluid is sprayed on both the windshield and rear glass.
8. Close and secure the engine cover.
9. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

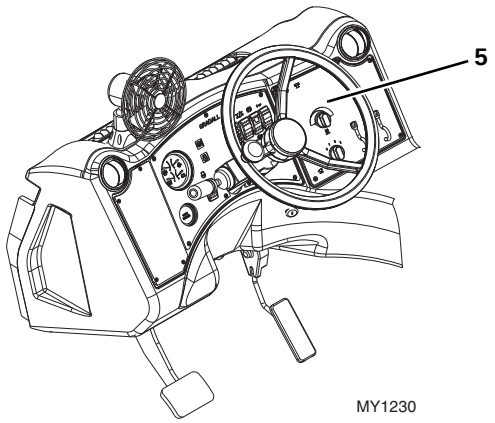
9.9 CAB HEATER AND FAN

9.9.1 Cab Heater Controls

Note: *If the suspect component is found to be within the heater box, the heater box must be removed as a complete unit and replaced.*

a. Cab Heater Controls Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Remove the screws securing the right cab dash panel (**5**).
6. Pull out the panel to gain access to the heater control electrical connections. Disconnect the harnesses.
7. Remove the heater control knobs.
8. Remove the necessary hardware securing the heater control from the dash panel. Remove the control from the panel.

b. Disassembly

DO NOT disassemble the cab heater and fan controls. The controls are not serviceable. Replace controls if found to be defective.

c. Installation and Testing

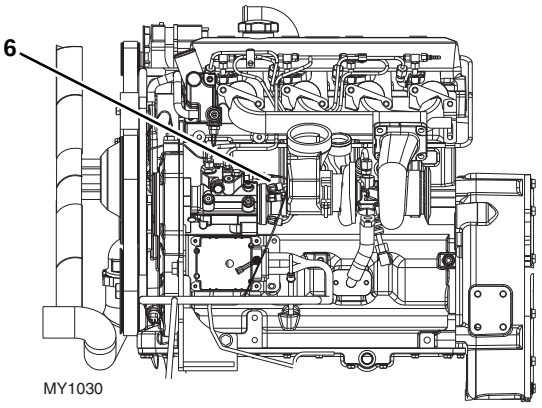
1. Check that the variable speed fan control is in the OFF position.
2. Install the heater controls to the dash panel with the previously used hardware.
3. Connect the cab electrical harness connector to the controls.
4. Install the control knobs.
5. Install the screws securing the dash panel to the cab.
6. Properly connect the battery.
7. Turn the ignition key to the ON position and check the fan speeds. If further repair is needed, refer to Section 9.5, “Electrical System Schematics.”
8. Start the machine and allow engine to warm to operating temperature. Check heat control at different levels.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.10 SOLENOIDS, SENSORS AND SENDERS

9.10.1 Fuel Shut-off Solenoid - John Deere

a. Fuel Shut-off Solenoid Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Disconnect the wiring connector at the fuel shut-off solenoid (**6**) lead.
6. Remove the fuel shut-off solenoid from the fuel injector pump.

b. Fuel Shut-off Solenoid Disassembly

DO NOT disassemble a fuel shut-off solenoid. Replace a defective fuel shut-off solenoid with a new part.

c. Fuel Shut-off Solenoid Inspection and Replacement

Use a 12-volt DC source and ground to test the solenoid. Energize the solenoid, and watch for the plunger to retract. If the plunger does not retract, replace the fuel shut-off solenoid with a new part.

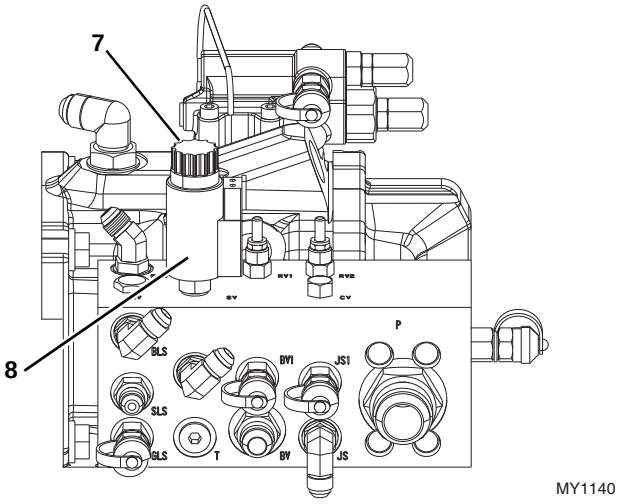
d. Fuel Shut-off Solenoid Installation

1. Clean the exterior of the fuel injector pump.
2. Install the fuel shut-off solenoid on the fuel injection pump. **Do Not Over Tighten**.
3. Connect the wiring connector at the fuel shut-off solenoid lead.
4. Properly connect the battery.
5. Start the engine. If the engine starts, the fuel shutoff solenoid is functioning. If the engine fails to start, the fuel shut-off run solenoid may have a poor ground connection. Visually check the wiring at the fuel shutoff solenoid leads and/or check for continuity with a voltmeter as required.
6. Check for fuel and/or oil leakage around the solenoid.
7. Close and secure the engine cover.
8. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.10.2 Park Brake Solenoid Valve

a. Park Brake Solenoid Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Disconnect the wiring connector at the park brake solenoid lead.



6. Remove the nut on the end of the park brake coil (**7**).
7. Remove the park brake coil.
8. Remove the park brake solenoid (**8**). (Remove only if the electrical coil is found to not be faulty.)

b. Disassembly

DO NOT disassemble the solenoid. The solenoid is not serviceable. Replace solenoid if found to be defective.

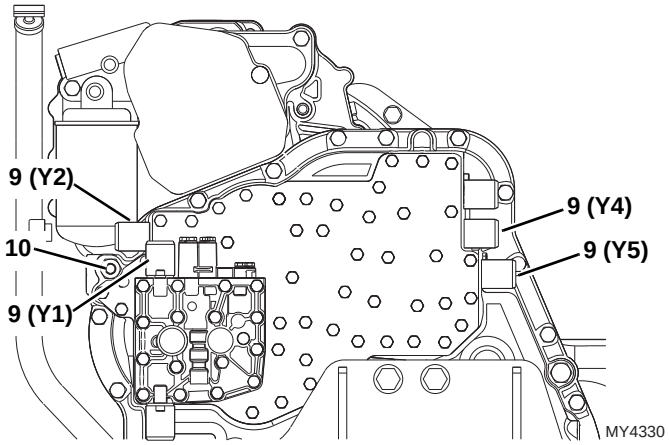
c. Park Brake Solenoid Valve Installation

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

1. If necessary, install the park brake solenoid in its original orientation.

2. Slide the park brake coil over the solenoid. Tighten the nut to secure the solenoid. DO NOT overtighten.
3. Connect the wiring connector to the park brake coil lead.
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.10.3 Transmission Solenoid Valves



Note: If the transmission is not shifting properly, the transmission shift control switch (travel select lever), wiring harness or transmission shift solenoids (**9**) should be checked in order to determine which component is defective. Specific information to determine which travel position and corresponding component is not responding can be found in the detailed transmission service instructions (covering repair, disassembly, reassembly and adjustment information) are provided in the ZF Powershift Transmission 4WG-92/98 TSC Repair Manual, (JLG P/N 31200241) and can be obtained by calling your local JLG dealer or ZF Service Center.

The transmission should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Note: *Contact the **JLG** Service Department if internal transmission repair is required during the warranty period.*

9.10.4 Transmission Temperature Sender

a. Transmission Temperature Sender Removal

The transmission temperature sender (**10**) is located at the bottom left side of the transmission housing.

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Unplug the transmission temperature sender connector from the wiring harness connector.
6. The sender is threaded into the transmission housing. Remove the sender.

b. Transmission Temperature Sender Inspection and Replacement

Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

c. Transmission Temperature Sender Installation and Testing

1. Thread the transmission temperature sender into the transmission housing snugly, then connect the sender connector to the wiring harness connector.
2. Properly connect the battery.
3. Check for proper fluid level.
4. Start the engine, allow it to reach operating temperature and observe the operator's display cluster for warning indication. If the sender is not defective, the problem could be elsewhere; possibly in a shorted wire, damaged transmission, improper or low fluid, etc.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

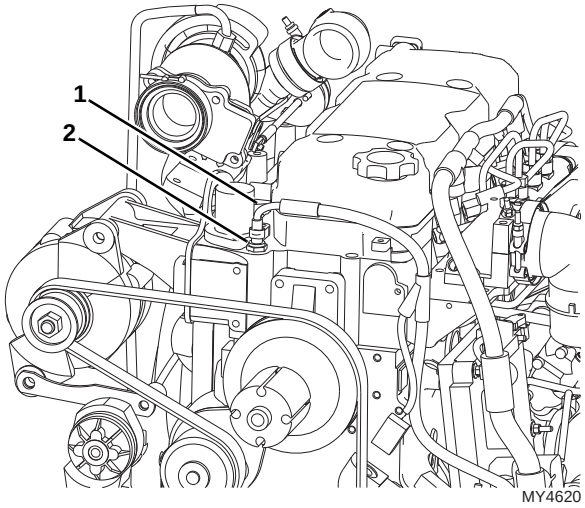
9.10.5 Engine Coolant Temperature Sender

a. Engine Coolant Temperature Sender Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.

2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.

CUMMINS ENGINE SHOWN



5. Unplug the engine coolant temperature sender connector (**1**) from the wiring harness connector.
6. The engine coolant temperature sender (**2**) is located near the upper radiator hose thermostat housing and threaded into the engine block. Remove the sender.

b. Engine Coolant Temperature Sender Inspection and Replacement

Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

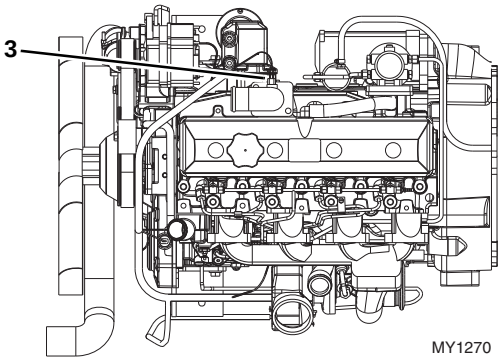
c. Engine Coolant Temperature Sender Installation and Testing

1. Thread the engine coolant temperature sender into the engine block snugly, then connect the sender connector to the wiring harness connector.
2. Properly connect the battery.
3. Check for proper coolant level.
4. Start the engine, allow it to reach operating temperature and observe the operator's instrument cluster for warning indication. If the sender is not defective, the problem could be elsewhere; possibly in a shorted wire, improper-running engine, improper or low coolant, obstructed or faulty radiator, coolant pump, loose fan belt, defective instrument display, etc.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.10.6 Air Manifold Temperature Sensor - John Deere

a. Air Manifold Temperature Sensor Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Unplug the engine coolant temperature sender/ switch connector from the wiring harness connector.
6. Unplug the air manifold temperature sensor connector from the wiring harness connector.



7. The air manifold temperature sensor (**3**) is threaded into the engine block. Remove the sender.

b. Air Manifold Temperature Sensor Inspection and Replacement

Inspect the sensor and the wiring harness connector terminals for continuity. Replace a defective or faulty sensor with a new part.

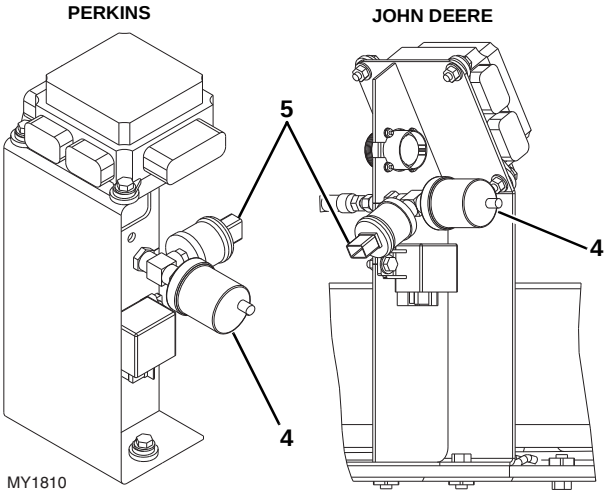
c. Air Manifold Temperature Sensor Installation and Testing

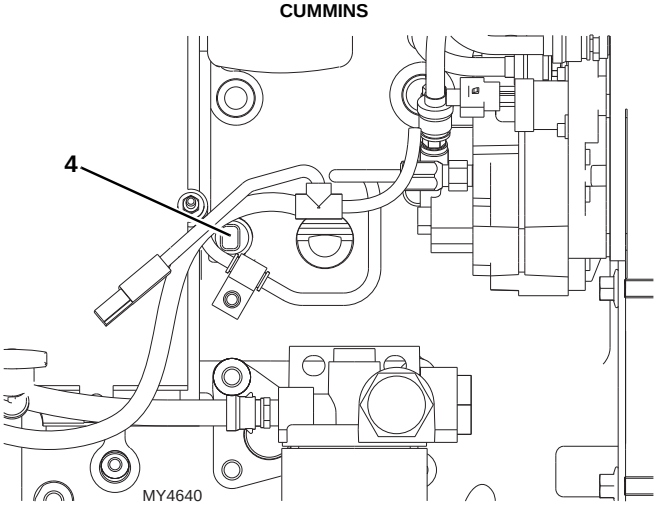
1. Thread the air manifold temperature sensor into the air manifold snugly, then connect the sensor connector to the wiring harness connector.
2. Properly connect the battery.
3. Check for proper coolant level.
4. Start the engine, allow it to reach operating temperature and observe the operator's instrument cluster for warning indication. If the sensor is not defective, the problem could be elsewhere; possibly in a shorted wire, improper-running engine, improper or low coolant, obstructed or faulty radiator, coolant pump, loose fan belt, defective instrument display, etc.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.10.7 Engine Oil Pressure Sender/Switch

a. Engine Oil Pressure Sender/Switch Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Unplug the engine oil pressure sender connector from the wiring harness connector.





6. Unplug the wiring harness connector from the engine oil pressure sender (**4**) or switch (**5**).
7. **John Deere/Perkins** - The engine oil pressure sender/switch is threaded into a fitting on the bracket weldment. Remove the sender/switch.
   Cummins - The engine oil pressure sender is threaded into the engine block directly above the oil filter. Remove the sender.

b. Engine Oil Pressure Sender Inspection and Replacement

Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

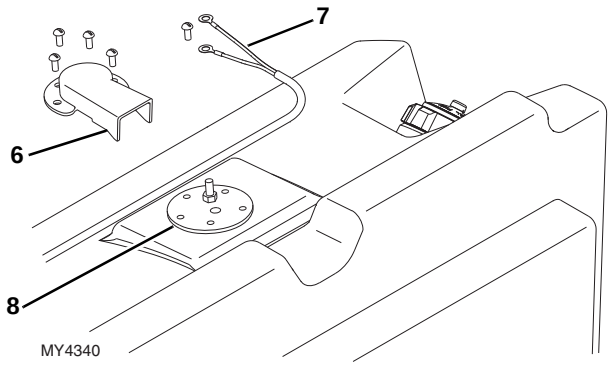
c. Engine Oil Pressure Sender Installation and Testing

1. Thread the engine oil pressure sender into the fitting or engine block snugly, then connect the sender connector to the wiring harness connector.
2. Properly connect the battery.
3. Check for proper oil level.
4. Start the engine, and observe the operator's display for warning indication. If the sender is not defective, the problem could be elsewhere; possibly in a shorted wire, improper-running engine, low oil, obstructed or faulty oil pump, defective instrument display.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.10.8 Fuel Level Sender

a. Fuel Level Indicator Testing

The fuel level sender wiring harness leads can be accessed from the top of the fuel tank.



1. Loosen and remove he four screws securing the fuel sender cover (**6**).
2. Disconnect the fuel level sender wiring harness leads (**7**) from the fuel sender (**8**). With the help of an assistant, touch both harness leads together.
3. From the operator's cab, have the assistant turn the ignition key switch to the RUN position. **DO NOT** start the engine. Observe the fuel level indicator needle on the operator's instrument cluster. The reading must be at the FULL mark.
4. Turn the ignition key switch to the OFF position. The fuel level indicator needle should return to the EMPTY position.

b. Fuel Level Circuit Tests

If the fuel level sender (**8**) is suspected of giving a false reading, perform the following checks:

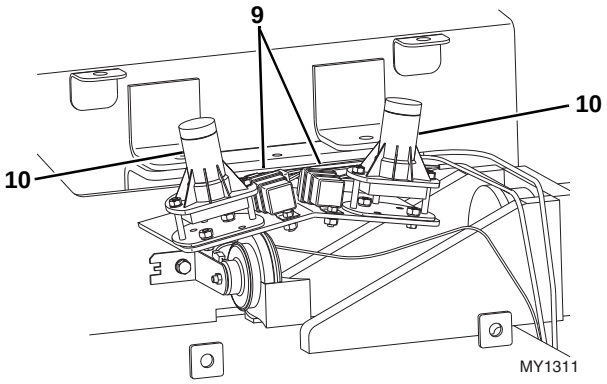
1. If the fuel level indicator needle does not move, check the fuel tank for fuel.
2. Check for loose or defective wiring, faulty ground connections, and corrosion on the fuel tank sender and wiring lead.
3. If the fuel level indicator needle does not move after the ignition key switch is turned to the RUN position, use a test lamp to determine whether current is flowing from the ignition switch to the fuel level sender.
4. If the fuel level indicator does not move and a faulty or defective fuel level sender in the fuel tank has been ruled out, and in addition, wiring and connectors have been checked and ruled out, the fuel level indicator is defective and must be replaced.
5. Check that the ignition terminal has current and that the fuse in the fuse panel is not blown.
6. Check for broken, shorted, frayed, disconnected or damaged wiring between the fuel level indicator wiring at the cab, fuse and relay panel, ignition key switch, and from the fuel level sender on the fuel tank through the wiring in the cab.
7. Check the fuel level sender. A defective fuel level sender in the fuel tank may also prevent the fuel level indicator from moving. Refer to Section 9.5, “Electrical System Schematics,” for further information.

9.10.9 Inclinometer Switch

G10-55A Before S/N 0160038543
G12-55A Before S/N 0160038542

a. Inclinometer Switch Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, raise and support the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the inclinometer switch protective cover.



6. Unplug and label the inclinometer switch connector (**9**) from the wiring harness connector.
7. Remove the hardware securing the inclinometer switch (**10**) to the machine frame.

b. Inclinometer Switch Installation

1. Install the inclinometer switch to the machine frame with the previously used hardware.
2. Connect the previously labeled wires to the inclinometer switch.
3. Install the inclinometer switch protective cover.
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Start the engine. Fully retract and level the boom and level the frame.
7. Locate a 12” curb and drive the left front and left rear tires onto the curb. Sway the machine to the right. When the frame is out of level by 15°, the machine will automatically sway back to 14.7°.
8. Repeat step 7 for the right side of the machine.
9. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.10.10 Front and Rear Axle Proximity Sensors

The sensors used on each axle allow the steering to be changed to one of three different settings. The sensors will not allow the change to be completed unless both axles are in the central location.

Each sensor is mounted in the center of each steer cylinder.

a. Removal

1. Open engine cover. Allow system fluids to cool.
2. Properly disconnect the battery.
3. Unplug the axle proximity sensor from the wiring harness.
4. Remove the bolts holding the sensor to the steering cylinder barrel.

b. Disassembly

1. Inspect the sensor and the wiring harness connector terminals for continuity. Replace a defective or faulty sensor with a new sensor.

c. Installation and Testing

1. Install the bolts holding the sensor to the steering cylinder barrel.
2. Connect the axle proximity sensor to the wiring harness.
3. Properly connect the battery.
4. Close and secure engine cover.
5. Start the machine, select a steering mode, turn the steering wheel until the display unit shows the steering has been "locked" into the selected mode.

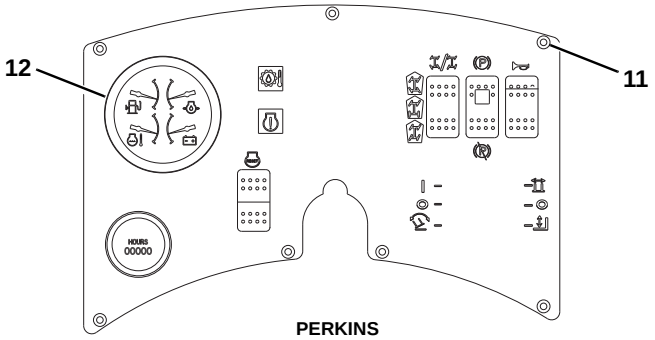
9.11 DISPLAY MONITOR AND GAUGES

9.11.1 Analog Gauges

a. Gauge Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.

JOHN DEERE



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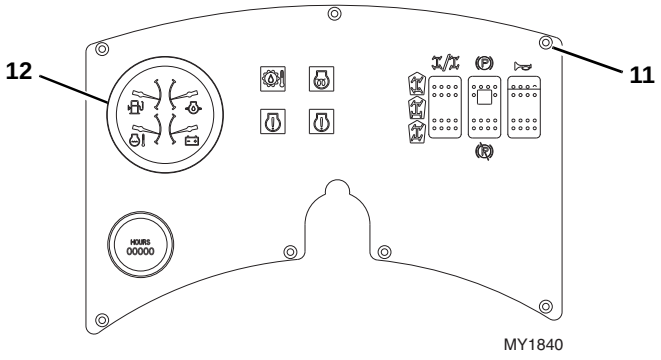
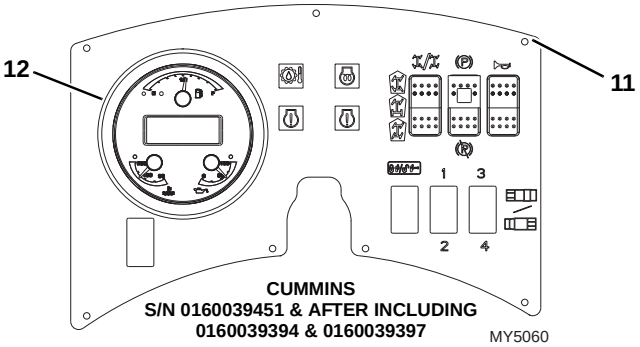


PERKINS
S/N 0160037186 THRU 0160039451
EXCLUDUING 0160039394 & 0160039397



CUMMINS
S/N 0160039451 & AFTER INCLUDING
0160039394 & 0160039397

5. Remove the screws (**11**) securing the dash panel.
6. Label and disconnect the wires from the gauge, remove the gauge bracket.
7. Pull the gauge (**12**) out from the dash.

b. Disassembly

DO NOT disassemble the gauge. The gauge is not serviceable. Replace the gauge if found to be defective.

c. Gauge Installation and Testing

1. Install the gauge (**12**) in the dash. Install the gauge bracket.
2. Connect the previously labeled wires to the gauge.
3. Install the dash panel with the previously used hardware (**11**).
4. Properly connect the battery.
5. Turn the ignition to the ON position to check the gauge values.
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.12 DASH SWITCHES

9.12.1 Ignition Key Switch

Note: *For information on the front windshield wiper, rear window wiper and washer systems, refer to Section 9.8, "Window Wiper/Washer Windshield Wiper Motor."*

a. Ignition Switch Removal

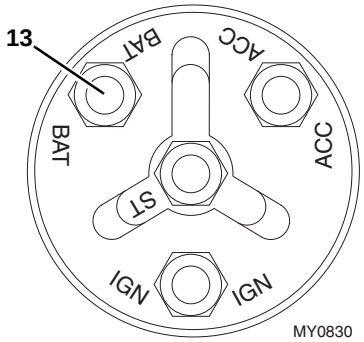
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the screws securing the dash panel.
6. Remove the hex nut securing the ignition key switch to the dash.
7. Label and disconnect the ignition switch wires and remove the switch from the machine.

b. Disassembly

DO NOT disassemble the ignition switch. Replace a defective switch with a new part.

c. Inspection and Replacement

To determine the proper operation of the ignition key switch, test the terminals on the back of the switch for continuity with an ohmmeter.



Test the ignition key switch for continuity, by checking from the BAT terminal (**13**) to each of the remaining terminals in their corresponding switch position.

If all terminals do not show proper continuity, replace the ignition switch.

d. Ignition Switch Installation

1. Connect the ignition key switch to the previously labeled wires.
2. Align the ignition switch in the dash so that when it is in the OFF position, the key slot is positioned vertically (straight up and down). Install the hex nut securing the ignition switch to the dash. **DO NOT** overtighten.
3. Install the dash panel with the previously used hardware.
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

Note: *If further information is needed, refer to Section 9.5, "Electrical System Schematics."*

9.12.2 Dash Switches

a. Switch Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. There are three frames with three switches in each frame.
6. Pull the frame out of the dash, disconnect the harness connector to the switch in question and push the switch out of the frame.

b. Disassembly

DO NOT disassemble the dash switch. Replace a defective switch with a new part.

c. Inspection and Replacement

Inspect the switch terminals for continuity and shorting in both the engaged and disengaged positions. Replace a defective or faulty switch with a new switch.

d. Switch Installation

1. Connect the switch to the cab harness connector.
2. Position the switch over the rectangular switch bezel and snap into position.
3. Properly connect the battery.
4. Start the machine and check the replaced switch for proper function.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.13 TROUBLESHOOTING - JOHN DEERE

9.13.1 Engine Fault Codes Retrieval

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL and engage the park brake.
2. Turn the ignition switch to “ON”.
3. Push down and hold the Reset button on the dash for 3-5 seconds. The fault lamp will begin to flash a code number.
   The light will flash the first digit then pause for a short time and then flash the second digit. If there are “active” codes, the system will first flash code 32. If there are no “active” codes, the system will flash code 88. The system will then flash code 33 if there are any “stored” fault codes. If there are no “stored” codes, the system will flash code 88.
4. Once the code is retrieved, turn the ignition OFF.

Note: *When the engine sensor inputs exceed normal operating ranges, the ECU will derate the amount of fuel that is delivered to the engine. A fault code will always accompany a fuel derate. If the engine is running at a much lower rate, check the fault codes first to see if the engine is experiencing an internal problem.*

9.13.2 Engine Fault Codes Chart

Fault Codes	SPN Codes	FMI Codes	Definition
11	N/A	N/A	Analog Throttle (A) Input High
12	N/A	N/A	Analog Throttle (B) Input High
18	110	3	Engine Coolant Temperature Input Voltage High
19	110	4	Engine Coolant Temperature Input Voltage Low
21	620	3	Sensor Supply Voltage High
	1079	3	Sensor Supply Voltage High
22	620	4	Sensor Supply Voltage Low
	1079	4	Sensor Supply Voltage Low
23	100	3	Engine Oil Pressure Input Voltage High
24	100	4	Engine Oil Pressure Input Voltage Low
25	105	3	Manifold Air Temperature Input Voltage High
26	105	4	Manifold Air Temperature Input Voltage Low
28	629	13	ECU Error
32	N/A	N/A	Signifies Start of Active Fault Codes
33	N/A	N/A	Signifies Start of Previously Active Fault Codes
37	174	3	Fuel Temperature Input Voltage High
38	174	4	Fuel Temperature Input Voltage Low
39	637	2	Crank Position Input Noise

Fault Codes	SPN Codes	FMI Codes	Definition
		10	Crank Position Input Pattern Error
42	190	0	Engine Overspeed Extreme
		16	Engine Overspeed Moderate
54	158	17	ECU Power Down Error
55	639	13	CAN Error
62	110	15	Engine Coolant Temperature High Least Service
63	110	16	Engine Coolant Temperature High Moderately Service
64	100	18	Engine Oil Pressure Moderately Low
65	100	1	Engine Oil Pressure Extremely Low
66	105	16	Manifold Air Temperature Moderately High
68	1569	31	Fuel Derate
69	110	0	Engine Coolant Temperature High Most Severe
71	1076	0	Pump Control Valve Closure Too Long
72	1076	1	Pump Control Valve Closure Too Short
73	1076	5	Pump Solenoid Circuit Open
74	1076	6	Pump Solenoid Circuit Severely Shorted
75	1076	7	Pump Control Valve Closure Not Detected
76	1076	10	Pump Solenoid Circuit Moderately Shorted
77	1076	3	Pump Solenoid Current High
78	200	13	Security Violation
79	2000	6	Internal ECU Error
81	174	16	Fuel Temperature Moderately High
82	1110	31	Engine Protection Shutdown
83	970	31	Auxiliary Engine Shutdown Switch Active
84	158	17	ECU Power Down Error
	971	31	External Derate Switch Active
88	N/A	N/A	Signifies No Fault Codes Are In Buffer

9.14 ENGINE INDICATOR LAMPS - PERKINS

Warning Lamp	Shutdown Lamp	Lamp State	Lamp Indication	Engine State
ON	ON	Bulb Check	When the ignition is turned on, the EMS shall illuminate each bulb for 2 seconds and extinguish them afterwards	Key on, but engine has yet to be cranked
OFF	OFF	No Faults Present	With both lamps off whilst engine is running then are no currently active warnings, diagnostics or events	Engine is running with no detected faults
ON	OFF	Active Diagnostic	Should the warning lamp illuminate during engine running, this indicates that an Active diagnostic (Electrical fault) is present	Engine is running normally, but has one or more faults with engine management system
ON	FLASH	Derate (Invoked by Active Diagnostic)	Should the warning lamp illuminate and the shutdown lamp flash during engine running, this indicates that an Active diagnostic (Electrical fault) is present. The diagnostic is sufficiently serious to invoke engine derate	Engine is running, but has one or more Active diagnostic events that have initiated engine derate
FLASH	OFF	Warning (Warning only)	Should the warning lamp flash during engine running, this indicates that one or more of the engine protection strategy warning values have been exceeded, but not to a level that will invoke Derate or Shutdown	Engine is running normally, but has one or more monitored engine parameters outside of the acceptable range
FLASH	FLASH	Derate (Warning and Derate)	Should both the Warning Lamp and Shutdown Lamp flash during engine running, this indicates that one, or more of the engine protection strategy values have been exceeded beyond the level required to invoke engine derate	Engine is running, but one or more of the monitored engine parameters has gone beyond that of warning only and has now exceeded those set for engine derate
ON	ON	Engine Shutdown	Should both the Warning Lamp and Shutdown Lamp illuminate during engine running this indicates that either: 1. One or more of the engine protection strategy shutdown values has been exceeded 2. A serious Active diagnostic has been detected ***Shortly after (time duration to be agreed) engine will shutdown***	Engine is either shutdown or shutdown is imminent, one of more monitored engine parameters have gone beyond that of warning or derate and have now exceeded those set for engine shutdown, or a serious Active diagnostic has been detected

9.15 SAE DIAGNOSTIC TROUBLE CODES AND FAULT CODES - CUMMINS

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
111	629	12	Red	Controller #1	Engine Control Module Critical internal failure - Bad intelligent Device or Component
115	612	2	Red	System Diagnostic Code #2	Engine Speed/Position Sensor Circuit lost both of two signals from the magnetic pickup sensor - Data Erratic, Intermittent, or incorrect
122	102	3	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
123	102	4	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
124	102	16	Amber	Boost Pressure	Intake Manifold 1 Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level
131	91	3	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit - Voltage Above Normal, or Shorted to High Source
132	91	4	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
133	974	3	Red	Remote Accelerator	Remote Accelerator Pedal or Lever Position Sensor Circuit - Voltage Above Normal, or Shorted to High Source
134	974	4	Red	Remote Accelerator	Remote Accelerator Pedal or Lever Position Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
135	100	3	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
141	100	4	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
143	100	18	Amber	Engine Oil Pressure	Oil Pressure Low - Data Valid but Below Normal Operational Range - Moderately Severe Level
144	110	3	Amber	Engine Coolant Temperature	Coolant Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
145	110	4	Amber	Engine Coolant Temperature	Coolant Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
146	110	16	Amber	Engine Coolant Temperature	Coolant Temperature High - Data Valid but Above Normal Operational Range - Moderately Severe Level
147	91	1	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit - Abnormal Frequency, Pulse Width, or Period
148	91	0	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit - Abnormal Frequency, Pulse Width, or Period
151	110	0	Red	Engine Coolant Temperature	Coolant Temperature Low - Data Valid but Above Normal Operational Range - Most Severe Level
153	105	3	Amber	Intake Manifold #1 Temp	Intake Manifold Air Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
154	105	4	Amber	Intake Manifold #1 Temp	Intake Manifold Air Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
155	105	0	Red	Intake Manifold #1 Temp	Intake Manifold Air Temperature High - Data Valid but Above Normal Operational Range - Most Severe Level
187	3510	4	Amber	5 Volts DC Supply	Sensor Supply Voltage #2 Circuit - Voltage Below Normal, or Shorted to Low Source
193	520199	3	Amber	Cruise Control	Cruise Control (Resistive) Signal Circuit - Voltage Above Normal, or Shorted to High Source
194	520199	4	Amber	Cruise Control	Cruise Control (Resistive) Signal Circuit - Voltage Below Normal, or Shorted to Low Source
195	111	3	Amber	Coolant Level	Coolant Level Sensor Circuit - Voltage Above Normal, or Shorted to High Source
196	111	4	Amber	Coolant Level	Coolant Level Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
197	111	18	Amber	Coolant Level	Coolant Level - Data Valid but Below Normal Operational Range - Moderately Severe Level
199	1661	4	Amber	Engine Automatic Start Lamp	Engine Automatic Start Lamp Driver Circuit - Voltage Above Normal, or Shorted to High Source
211	1484	31	None	J1939 Error	Additional Auxiliary Diagnostic Codes logged - Condition Exists

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
212	175	3	Amber	Oil Temperature	Engine Oil Temperature Sensor 1 Circuit - Voltage Above Normal, or Shorted to High Source
213	175	4	Amber	Oil Temperature	Engine Oil Temperature Sensor 1 Circuit - Voltage Below Normal, or Shorted to Low Source
214	175	0	Red	Oil Temperature	Engine Oil Temperature - Data Valid but Above Normal Operational Range - Most Severe Level
221	108	3	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
222	108	4	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
227	3510	3	Amber	5 Volts DC Supply	Sensor Supply Voltage #2 Circuit - Voltage Above Normal, or Shorted to High Source
231	109	3	Amber	Coolant Pressure	Coolant Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
232	109	4	Amber	Coolant Pressure	Coolant Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
233	109	18	Amber	Coolant Pressure	Coolant Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level
234	190	0	Red	Engine Speed	Engine Speed High - Data Valid but Above Normal Operational Range - Most Severe Level
235	111	1	Red	Coolant Level	Coolant Level Low - Data Valid but Below Normal Operational Range - Most Severe Level
237	644	2	Amber	External Speed Input	External Speed Input (Multiple Unit Synchronization) - Data Erratic, Intermittent, or Incorrect
238	3511	4	Amber	System Diagnostic code #1	Sensor Supply Voltage #3 Circuit - Voltage Below Normal, or Shorted to Low Source
239	3511	3	Amber	System Diagnostic code #2	Sensor Supply Voltage #3 Circuit - Voltage Above Normal, or Shorted to High Source
241	84	2	Amber	Wheel-based Vehicle Speed	Vehicle Speed Sensor Circuit - Data Erratic, Intermittent, or Incorrect
242	84	10	Amber	Wheel-based Vehicle Speed	Vehicle Speed Sensor Circuit tampering has been detected - Abnormal Rate of Change
244	623	4	Amber	Red Stop Lamp	Red Stop Lamp Driver Circuit - Voltage Below Normal, or Shorted to Low Source

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
245	647	4	Amber	Fan Clutch Output Device Driver	Fan Control Circuit - Voltage Below Normal, or Shorted to Low Source
249	171	3	Amber	Ambient Air Temperature	Ambient Air Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
256	171	4	Amber	Ambient Air Temperature	Ambient Air Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
261	174	16	Amber	Fuel Temperature	Engine Fuel Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level
263	174	3	Amber	Fuel Temperature	AEB15.60 Page 149 of 157 Engine Fuel Temperature Sensor 1 Circuit - Voltage Above Normal, or Shorted to High Source
265	174	4	Amber	Fuel Temperature	Engine Fuel Temperature Sensor 1 Circuit - Voltage Below Normal, or Shorted to Low Source
268	94	2	Amber	Fuel Delivery Pressure	Fuel Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
271	1347	4	Amber	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve Circuit - Voltage Below Normal, or Shorted to Low Source
272	1347	3	Amber	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve Circuit - Voltage Above Normal, or Shorted to High Source
281	1347	7	Amber	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve #1 - Mechanical System Not Responding Properly or Out of Adjustment
284	1043	4	Amber	Internal Sensor Voltage Supply	Engine Speed/Position Sensor (Crankshaft) Supply Voltage Circuit - Voltage Below Normal, or Shorted to Low Source
285	639	9	Amber	SAE J1939 Datalink	SAE J1939 Multiplexing PGN Timeout Error - Abnormal Update Rate
286	639	13	Amber	SAE J1939 Datalink	SAE J1939 Multiplexing Configuration Error-Out of Calibration
287	91	19	Red	Accelerator Pedal Position	SAE J1939 Multiplexing Accelerator Pedal or Lever Sensor System Error - Received Network Data In Error
288	974	19	Red	Remote Accelerator	SAE J1939 Multiplexing Remote Accelerator Pedal or Lever Data Error - Received Network Data In Error

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
292	441	14	Red	Auxiliary Temperature 1	Auxiliary Temperature Sensor Input 1 - Special Instructions
293	441	3	Amber	OEM Temperature	Auxiliary Temperature Sensor Input #1 Circuit - Voltage Above Normal, or Shorted to High Source
294	441	4	Amber	OEM Temperature	Auxiliary Temperature Sensor Input #1 Circuit - Voltage Below Normal, or Shorted to Low Source
295	108	2	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
296	1388	14	Red	Auxiliary Pressure	Auxiliary Pressure Sensor Input 1 - Special Instructions
297	1388	3	Amber	Auxiliary Pressure	Auxiliary Pressure Sensor Input #2 Circuit - Voltage Above Normal, or Shorted to High Source
298	1388	4	Amber	Auxiliary Pressure	Auxiliary Pressure Sensor Input #2 Circuit - Voltage Below Normal, or Shorted to Low Source
319	251	2	Maint	Real Time Clock Power	Real Time Clock Power Interrupt - Data Erratic, Intermittent, or Incorrect
322	651	5	Amber	Injector Cylinder #01	Injector Solenoid Cylinder #1 Circuit - Current Below Normal, or Open Circuit
323	655	5	Amber	Injector Cylinder #05	Injector Solenoid Cylinder #5 Circuit - Current Below Normal, or Open Circuit
324	653	5	Amber	Injector Cylinder #03	Injector Solenoid Cylinder #3 Circuit - Current Below Normal, or Open Circuit
325	656	5	Amber	Injector Cylinder #06	Injector Solenoid Cylinder #6 Circuit - Current Below Normal, or Open Circuit
331	652	5	Amber	Injector Cylinder #02	Injector Solenoid Cylinder #2 Circuit - Current Below Normal, or Open Circuit
332	654	5	Amber	Injector Cylinder #04	Injector Solenoid Cylinder #4 Circuit - Current Below Normal, or Open Circuit
334	110	2	Amber	Engine Coolant Temperature	Coolant Temperature Sensor Circuit - Data Erratic, Intermittent, or Incorrect
338	1267	3	Amber	Vehicle Accessories Relay Driver	Idle Shutdown Vehicle Accessories Relay Driver Circuit - Voltage Above Normal, or Shorted to High Source
339	1267	4	Amber	Vehicle Accessories Relay Driver	Idle Shutdown Vehicle Accessories Relay Driver Circuit - Voltage Below Normal, or Shorted to Low Source

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
341	630	2	Amber	Calibration Memory	Engine Control Module data lost - Data Erratic, Intermittent, or Incorrect
342	630	13	Red	Calibration Memory	Electronic Calibration Code Incompatibility - Out of Calibration
343	629	12	Amber	Controller #1	Engine Control Module Warning internal hardware failure - Bad Intelligent Device or Component
349	191	16	Amber	Transmission Output Shaft Speed	Transmission Output Shaft Speed - Data Valid but Above Normal Operational Range - Moderately Severe Level
351	627	12	Amber	Controller #1	Injector Power Supply - Bad Intelligent Device or Component
352	3509	4	Amber	5 Volts DC Supply	Sensor Supply Voltage #1 Circuit - Voltage Below Normal, or Shorted to Low Source
386	3509	3	Amber	5 Volts DC Supply	Sensor Supply Voltage #1 Circuit - Voltage Above Normal, or Shorted to High Source
415	100	1	Red	Engine Oil Pressure	Oil Pressure Low - Data Valid but Below Normal Operational Range - Most Severe Level
418	97	15	Maint.	Water in Fuel Indicator	Water in Fuel Indicator High - Data Valid but Above Normal Operational Range - Least Severe Level
422	111	2	Amber	Coolant Level	Coolant Level - Data Erratic, Intermittent, or Incorrect
425	175	2	Amber	Oil Temperature	Engine Oil Temperature - Data Erratic, Intermittent, or Incorrect
428	97	3	Amber	Water in Fuel Indicator	Water in Fuel Sensor Circuit - Voltage Above Normal, or Shorted to High Source
429	97	4	Amber	Water in Fuel Indicator	Water in Fuel Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
431	558	2	Amber	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent, or Incorrect
432	558	13	Red	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Out of Calibration
435	100	2	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
441	168	18	Amber	Electrical Potential (Voltage)	Battery #1 Voltage Low - Data Valid but Below Normal Operational Range - Moderately Severe Level

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
442	168	16	Amber	Electrical Potential (Voltage)	Battery #1 Voltage High - Data Valid but Above Normal Operational Range - Moderately Severe Level
449	157	0	Red	Injector Metering Rail 1 Pressure	Fuel Pressure High - Data Valid but Above Normal Operational Range - Moderately Severe Level
451	157	3	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
452	157	4	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
488	105	16	Amber	Intake Manifold	Intake Manifold 1 Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level
489	191	18	Amber	Transmission Output Shaft Speed	Transmission Output Shaft Speed - Data Valid but Below Normal Operational Range - Moderately Severe Level
497	1377	2	Amber	Switch Circuit	AEB15.60 Page 151 of 157 Multiple Unit Synchronization Switch Circuit - Data Erratic, Intermittent, or Incorrect
523	611	2	Amber	System Diagnostic code #1	OEM Intermediate (PTO) Speed switch Validation - Data Erratic, Intermittent, or Incorrect
527	702	3	Amber	Circuit - Voltage	Auxiliary Input/Output 2 Circuit - Voltage Above Normal, or Shorted to High Source
528	93	2	Amber	Switch - Data	Auxiliary Alternate Torque Validation Switch - Data Erratic, Intermittent, or Incorrect
529	703	3	Amber	Circuit - Voltage	Auxiliary Input/Output 3 Circuit - Voltage Above Normal, or Shorted to High Source
546	94	3	Amber	Fuel Delivery Pressure	Fuel Delivery Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
547	94	4	Amber	Fuel Delivery Pressure	Fuel Delivery Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
551	558	4	Amber	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal, or Shorted to Low Source
553	157	16	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure High - Data Valid but Above Normal Operational Range - Moderately Severe Level

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
554	157	2	Amber	Injector Metering Rail 1 Pressure	Fuel Pressure Sensor Error - Data Erratic, Intermittent, or Incorrect
559	157	18	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure Low - Data Valid but Below Normal Operational Range - Moderately Severe Level
584	677	3	Amber	Starter Solenoid Lockout Relay Driver Circuit	Starter Relay Circuit - Voltage Above Normal, or Shorted to High Source
585	677	4	Amber	Starter Solenoid Lockout Relay Driver Circuit	Starter Relay Circuit - Voltage Below Normal, or Shorted to Low Source
595	103	16	Amber	Turbocharger 1 Speed	Turbocharger #1 Speed High - Data Valid but Above Normal Operational Range - Moderately Severe Level
596	167	16	Amber	Alternate Potential (voltage)	Electrical Charging System Voltage High - Data Valid but Above Normal Operational Range - Moderately Severe Level
597	167	18	Amber	Alternate Potential (voltage)	Electrical Charging System Voltage Low - Data Valid but Below Normal Operational Range - Moderately Severe Level
598	167	1	Red	Alternate Potential (voltage)	Electrical Charging System Voltage Low - Data Valid but Below Normal Operational Range - Most Severe Level
599	640	14	Red	Engine External Protection Input	Auxiliary Commanded Dual Output Shutdown - Special Instructions
649	1378	31	Maint	Engine Oil Change Interval	Change Lubricating Oil and Filter - Condition Exists
687	103	18	Amber	Turbocharger 1 Speed	Turbocharger #1 Speed Low - Data Valid but Below Normal Operational Range - Moderately Severe Level
689	190	2	Amber	Engine Speed	Primary Engine Speed Sensor Error - Data Erratic, Intermittent, or Incorrect
691	1172	3	Amber	Turbocharger #1 Compressor Inlet Temperature	Turbocharger #1 Compressor Inlet Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
692	1172	4	Amber	Turbocharger #1 Compressor Inlet Temperature	Turbocharger #1 Compressor Inlet Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
697	1136	3	Amber	Sensor Circuit - Voltage	ECM Internal Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
698	1136	4	Amber	Sensor Circuit - Voltage	ECM Internal Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
719	22	3	Amber	Crankcase Pressure	AEB15.60 Page 152 of 157 Extended Crankcase Blow-by Pressure Circuit - Voltage Above Normal, or Shorted to High Source
729	22	4	Amber	Crankcase Pressure	Extended Crankcase Blow-by Pressure Circuit - Voltage Below Normal, or Shorted to Low Source
731	723	7	Amber	Engine Speed Sensor #2	Engine Speed/Position #2 mechanical misalignment between camshaft and crankshaft sensors - Mechanical System Not Responding Properly or Out of Adjustment
757	2802	31	Amber	Electronic Control Module	Electronic Control Module data lost - Condition Exists
778	723	2	Amber	Engine Speed Sensor #2	Engine Speed Sensor (Camshaft) Error - Data Erratic, Intermittent, or Incorrect
779	703	11	Amber	Auxiliary Equipment Sensor Input	Warning Auxiliary Equipment Sensor Input #3 (OEM Switch) - Root Cause Not Known
951	166	2	None	Cylinder Power	Cylinder Power Imbalance Between Cylinders - Data Erratic, Intermittent, or Incorrect
1117	627	2	None	Power Supply	Power Lost With Ignition On - Data Erratic, Intermittent, or Incorrect
1139	651	7	Amber	Injector Cylinder #01	Injector Cylinder #1 - Mechanical System Not Responding Properly or Out of Adjustment
1141	652	7	Amber	Injector Cylinder #02	Injector Cylinder #2 - Mechanical System Not Responding Properly or Out of Adjustment
1142	653	7	Amber	Injector Cylinder #03	Injector Cylinder #3 - Mechanical System Not Responding Properly or Out of Adjustment
1143	654	7	Amber	Injector Cylinder #04	Injector Cylinder #4 - Mechanical System Not Responding Properly or Out of Adjustment
1144	655	7	Amber	Injector Cylinder #05	Injector Cylinder #5 - Mechanical System Not Responding Properly or Out of Adjustment
1145	656	7	Amber	Injector Cylinder #06	Injector Cylinder #6 - Mechanical System Not Responding Properly or Out of Adjustment
1239	2623	3	Amber	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Above Normal, or Shorted to High Source

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
1241	2623	4	Amber	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Below Normal, or Shorted to Low Source
1242	91	2	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor 1 and 2 - Data Erratic, Intermittent, or Incorrect
1256	1563	2	Amber	Control Module Identification Input State	Control Module Identification Input State Error - Data Erratic, Intermittent, or Incorrect
1257	1563	2	Red	Control Module Identification Input State	Control Module Identification Input State Error - Data Erratic, Intermittent, or Incorrect
1852	97	16	Amber	Water in Fuel Indicator	Water in Fuel Indicator - Data Valid but Above Normal Operational Range - Moderately Severe Level
1911	157	0	Amber	Injector Metering Rail	Injector Metering Rail 1 Pressure - Data Valid but Above Normal Operational Range - Most Severe Level
2111	52	3	Amber	Coolant Temperature	Coolant Temperature 2 Sensor Circuit - Voltage Above Normal, or Shorted to High Source
2112	52	4	Amber	Coolant Temperature	Coolant Temperature 2 Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
2113	52	16	Amber	Coolant Temperature	Coolant Temperature 2 - Data Valid but Above Normal Operational Range - Moderately Severe Level
2114	52	0	Red	Coolant Temperature	Coolant Temperature 2 - Data Valid but Above Normal Operational Range - Most Severe Level
2115	2981	3	Amber	Coolant Pressure	Coolant Pressure 2 Circuit - Voltage Above Normal, or Shorted to High Source
2116	2981	4	Amber	Coolant Pressure	AEB15.60 Page 153 of 157 Coolant Pressure 2 Circuit - Voltage Below Normal, or Shorted to Low Source
2117	2981	18	Amber	Coolant Pressure	Coolant Pressure 2 - Data Valid but Below Normal Operational Range - Moderately Severe Level
2182	1072	3	Amber	Engine Brake Output #1	Engine Brake Actuator Driver 1 Circuit - Voltage Above Normal, or Shorted to High Source
2183	1072	4	Amber	Engine Brake Output #1	Engine Brake Actuator Driver 1 Circuit - Voltage Below Normal, or Shorted to Low Source
2185	3512	3	Amber	System Diagnostic code #1	Sensor Supply Voltage #4 Circuit - Voltage Above Normal, or Shorted to High Source

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
2186	3512	4	Amber	System Diagnostic code #1	Sensor Supply Voltage #4 Circuit - Voltage Below Normal, or Shorted to Low Source
2195	703	14	Red	Auxiliary Equipment Sensor	Auxiliary Equipment Sensor Input 3 Engine Protection Critical - Special Instructions
2215	94	18	Amber	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level
2216	94	1	Amber	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level
2217	630	31	Amber	Calibration Memory	ECM Program Memory (RAM) Corruption - Condition Exists
2249	157	1	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure - Data Valid but Below Normal Operational Range - Most Severe Level
2261	94	15	Maint	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Above Normal Operational Range - Least Severe Level
2262	94	17	Maint	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Below Normal Operational Range - Least Severe Level
2263	1800	16	Amber	Battery Temperature	Battery Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level
2264	1800	18	Amber	Battery Temperature	Battery Temperature - Data Valid but Below Normal Operational Range - Moderately Severe Level
2265	1075	3	Amber	Electric Lift Pump for Engine Fuel	Fuel Priming Pump Control Signal Circuit - Voltage Above Normal, or Shorted to High Source
2266	1075	4	Amber	Electric Lift Pump for Engine Fuel	Fuel Priming Pump Control Signal Circuit - Voltage Below Normal, or Shorted to Low Source
2292	611	16	Amber	Fuel Inlet Meter Device	Fuel Inlet Meter Device - Data Valid but Above Normal Operational Range - Moderately Severe Level
2293	611	18	Amber	Fuel Inlet Meter Device	Fuel Inlet Meter Device flow demand lower than expected - Data Valid but Below Normal Operational Range - Moderately Severe Level
2311	633	31	Amber	Fuel Control Valve #1	Fueling Actuator #1 Circuit Error - Condition Exists

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
2321	190	2	None	Engine Speed	Engine Speed / Position Sensor #1 - Data Erratic, Intermittent, or Incorrect
2322	723	2	None	Engine Speed Sensor #2	Engine Speed / Position Sensor #2 - Data Erratic, Intermittent, or Incorrect
2345	103	10	Amber	Turbocharger 1 Speed	Turbocharger speed invalid rate of change detected - Abnormal Rate of Change
2346	2789	15	None	System Diagnostic Code #1	Turbocharger Turbine Inlet Temperature (Calculated) - Data Valid but Above Normal Operational Range - Least Severe Level
2347	2790	15	None	System Diagnostic Code #1	Turbocharger Compressor Outlet Temperature (Calculated) - Data Valid but Above Normal Operational Range - Least Severe Level
2363	1073	4	Amber	Engine Compression Brake Output #2	Engine Brake Actuator Circuit #2 - Voltage Below Normal, or Shorted to Low Source
2365	1112	4	Amber	Engine Brake Output #3	Engine Brake Actuator Driver Output 3 Circuit - Voltage Below Normal, or Shorted to Low Source
2367	1073	3	Amber	Engine Compression Brake Output #2	Engine Brake Actuator Circuit #2 - Voltage Above Normal, or Shorted to High Source
2368	1112	3	Amber	Engine Brake Output #3	Engine Brake Actuator Driver 3 Circuit - Voltage Above Normal, or Shorted to High Source
2372	95	16	Amber	Engine Fuel Filter Differential Pressure	Fuel Filter Differential Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level
2373	1209	3	Amber	Exhaust Gas Pressure	Exhaust Gas Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
2374	1209	4	Amber	Exhaust Gas Pressure	Exhaust Gas Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
2375	412	3	Amber	Exhaust Gas Recirculation Temperature	Exhaust Gas Recirculation Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
2376	412	4	Amber	Exhaust Gas Recirculation Temperature	Exhaust Gas Recirculation Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
2377	647	3	Amber	Fan Clutch Output Device Driver	Fan Control Circuit - Voltage Above Normal, or Shorted to High Source
2425	730	4		Intake Air Heater #2	Intake Air Heater 2 Circuit - Voltage Below Normal, or Shorted to Low Source
2426	730	3		Intake Air Heater #2	Intake Air Heater 2 Circuit - Voltage Above Normal, or Shorted to High Source

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
2555	729	3	Amber	Inlet Air Heater Driver #1	Intake Air Heater #1 Circuit - Voltage Above Normal, or Shorted to High Source
2556	729	4	Amber	Inlet Air Heater Driver #1	Intake Air Heater #1 Circuit - Voltage Below Normal, or Shorted to Low Source
2557	697	3	Amber	Auxiliary PWM Driver #1	Auxiliary PWM Driver #1 - Voltage Above Normal, or Shorted to High Source
2558	697	4	Amber	Auxiliary PWM Driver #1	Auxiliary PWM Driver #1 - Voltage Below Normal, or Shorted to Low Source
2963	110	15	None	Engine Coolant Temperature	Engine Coolant Temperature High - Data Valid but Above Normal Operational Range - Least Severe Level
2973	102	2	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect

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